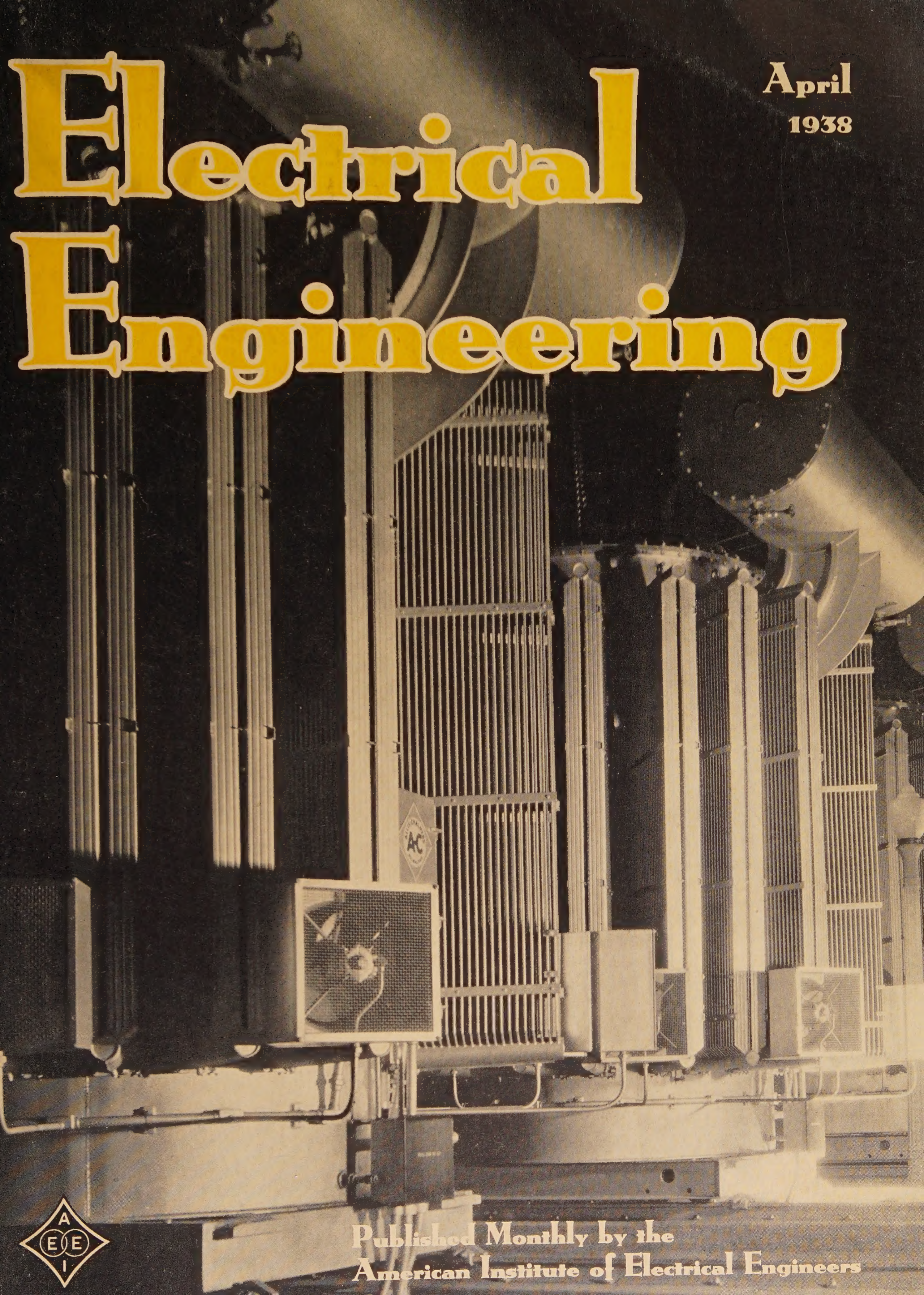
Electrical Engineering

April 1938



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*Transactions Section—Papers and Correlated Discussions** *(Follows EE page 190)*

* For discussions of previously published papers, see next page.

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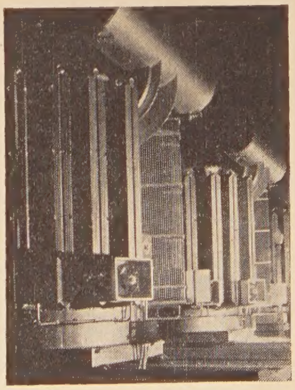
The Cover

A bank of three-winding power transformers with forced air cooling

Photo courtesy
Allis-Chalmers *Electrical Review*



High Lights

Discussions. This issue marks another step in the transition from the publication policy in effect during the years 1934–37 to the new plan adopted this year. In the TRANSACTIONS Section, all papers are published with correlated discussions. Discussions on some previously published papers still remain to be published; discussions of three such papers are included in this issue; others will appear in early issues. When the transition is complete, *all* discussions will be correlated with their respective papers.

Science and the Future of Aircraft. Within a few years, passengers will cross the Atlantic in less than 20 hours on 100-ton flying boats. Practical considerations probably will limit aircraft operating speeds to between 200 and 300 miles per hour during the coming decade, but a certain increase in speed may be expected from operating at high altitudes. These are some of the predictions made by a noted aviation authority (*pages 149–53*).

Co-ordination of Transformers. To co-ordinate or protect transformers intelligently for all kinds of impulse waves requires an accurate knowledge of the volt-time characteristics of transformer insulations. Laboratory tests made to determine these characteristics, based upon the effect of both single and repeated applications of impulse voltages on both the corona voltage level and the breakdown, are reported in a paper in this issue (*Transactions pages 183–95*).

Lightning Protection. Several different arrangements are used to protect distribution transformers from lightning damage; a comprehensive collection of data for various kinds of distribution-transformer failures caused by lightning in many widely scattered locations and of different voltage classes seems to indicate that solid interconnection in which the arrester ground lead is interconnected with the secondary neutral reduces failures (*Transactions pages 196–220*).

Oscillograms and Welding Performance. An arc-welding generator supplies energy to a load in which conditions are continually changing; consequently, the so-called "transient" performance is more important than the static, or steady-state, performance of the machine. The transient or dynamic voltage-current curves of welding generators as determined by oscillograms are discussed in this issue (*Transactions pages 177–82*).

Economics, Politics, and Government. Some observations on economics, politics, and government have been made by an engineer who has had an opportunity to study governments in various parts of the world for the last 20 years. One important observation is: "that the trend of many governments today . . . is . . . toward too . . . great a control over every area of the lives of men" (*pages 164–7*).

Summer Convention. Committees are busy planning the program of the AIEE 1938 summer convention to be held in Washington, D. C., June 20–24. Tentative plans call for 1 general session, 11 technical sessions, and 5 technical conferences, with the usual flavor of entertainment and sport features and interesting trips to points of interest in this historical center (*page 178*).

Slide-Back Voltmeter. Peak values of small alternating voltages may be measured accurately by the use of a slide-back voltmeter (a kind of vacuum-tube voltmeter) employing a tube having a steep current-voltage curve and the application of a correction factor (*Transactions pages 171–6*).

Conversion From 2.3 to 4 Kv. Because such a project usually involves a large area, the many details involved in converting distribution feeders from 2.3- to 4-kv operation must be co-ordinated accurately by a definite system of planning. One successful method of procedure is outlined in this issue (*pages 172–5*).

North Eastern District Meeting. A tentative technical program has been announced for the AIEE North Eastern District meeting to be held May 18–20, 1938, at Lenox, Mass. The meeting program will include entertainment, sight-seeing trips, and inspection trips to nearby industries (*pages 176–7*).

Pacific Coast Convention. Dates for the AIEE 1938 Pacific Coast convention, August 9–12, to be held in Portland, Ore., are almost a month earlier than usual in order to provide a better opportunity for combined vacation-convention trips (*page 179*).

Corrosion of Lead Sheath. Before measures to protect the lead sheath of underground cables from corrosion can be planned, the cause of the corrosion must be known. Several methods of determining the cause are in use (*pages 168–71*).

European Switchgear. Wide differences exist in the design of switchgear for electric-power systems between the United States and European countries; the latter depend largely on circuit breakers containing little or no oil (*pages 155–63*).

Coming Soon. Now undergoing preparation for publication in early issues are the following: An article on radioactivity by K. K. Darrow, noted writer on physical subjects; four papers on a carrier telephone system for toll cables and related problems and equipment by nine Bell-System engineers—C. W. Green, E. I. Green, R. W. Chesnut, L. M. Ilgenfritz, A. Kenner, C. E. Lane, M. A. Weaver, R. S. Tucker, and P. S. Darnell; a paper on modern city transportation by E. J. McIlraith; two papers on nonlinear circuits of the "ferro-resonant" type, by I. A. Travis and C. N. Weygandt, and P. H. Odessey and Ernst Weber; a paper on electronic speed control of motors by E. F. W. Alexanderson, M. A. Edwards, and C. H. Willis; and a paper describing a method of preventing the operation of differential relays on unbalanced currents not resulting from faults, by L. F. Kennedy and C. D. Hayward.

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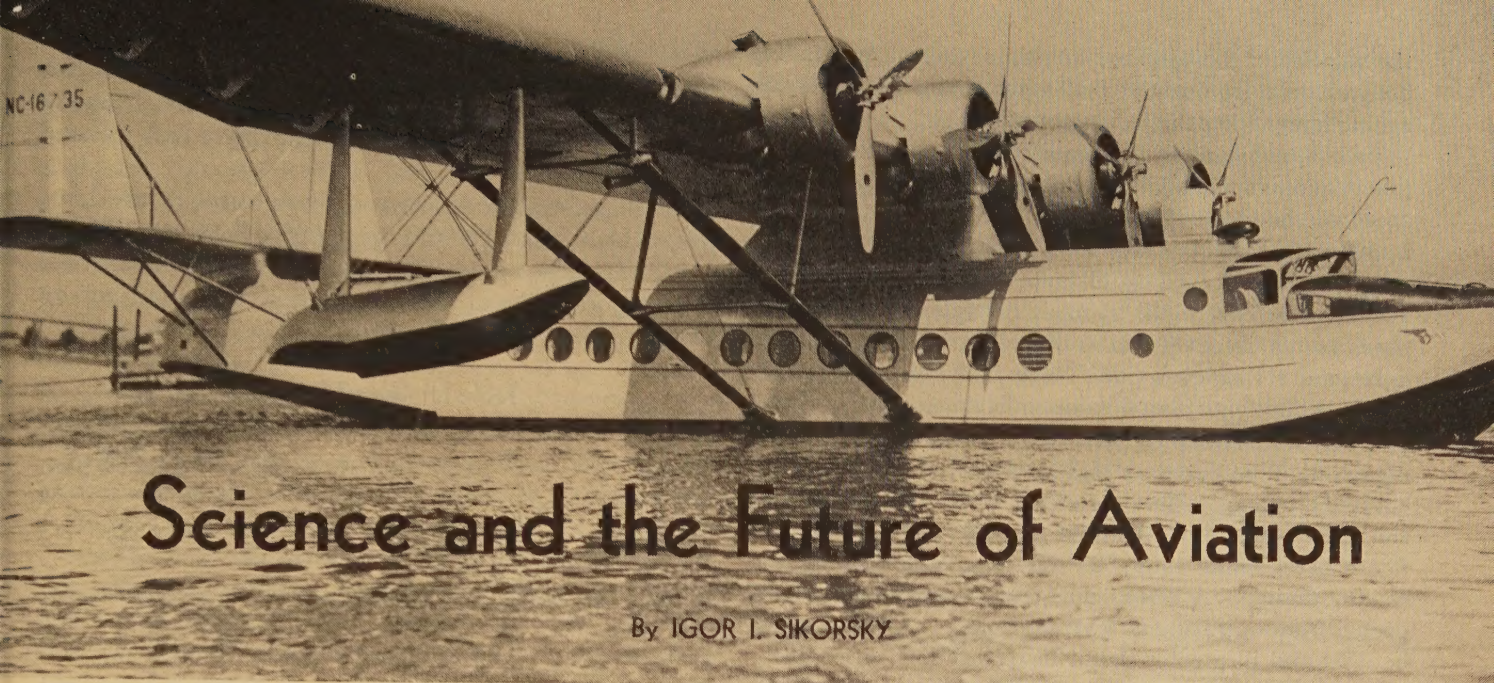
DISCUSSIONS

Appearing in this issue are discussions of the following previously published papers:

Electric Welding



Science and the Future of Aviation

By IGOR I. SIKORSKY

IN ANALYZING the probable future trend in the development of aviation, it appears desirable to limit the discussion to the study of three major factors, the combined effect of which to a large extent will determine the most interesting future developments. The characteristics under discussion will be speed, altitude of flight, and possible size of aircraft.

Speed

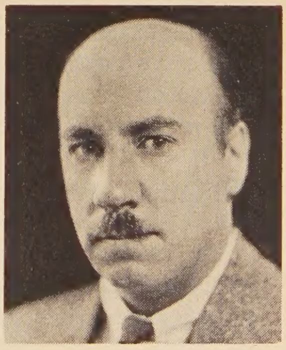
The possibility of traveling at great speed is the major reason for flying. A study of this factor and its future development is, therefore, of particular interest. The progress that has been made in this respect may be seen from table I, which includes some of the world records established between 1909 and the present time.

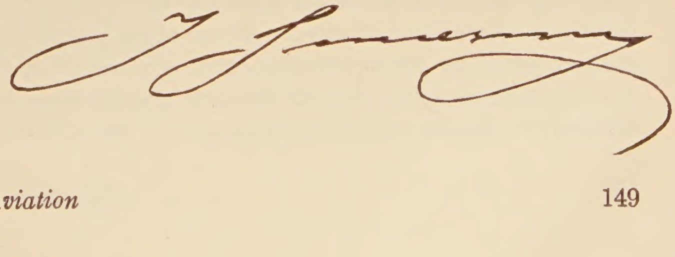
The present record of 440.62 miles per hour, or 646 feet per second, is equal to about one-half of the velocity of an average revolver bullet. Traveling at such speed, one would reach Times Square in New York City in about 19 minutes after leaving Schenectady, N. Y. A heavy load dropped from the top of the Empire State Building, which is about 1,200 feet high, would reach the pavement at a velocity less than one-half that of this aircraft even if the resistance of the air is disregarded. In order that

Travel by air is now a well-established method of communication. It is no longer an event to board an airliner in New York with air passage to Rio de Janeiro, or to Hongkong, and from there to fly further along established airlines to Europe, Africa, or Australia. The highly interesting and romantic pioneering period of aviation appears to have been concluded by a series of important achievements, the last of which was the establishment of regular transoceanic air service by the American flying clipper ships.

Aviation by now is a valuable factor in national life. It is an important branch of the armed forces. A vital factor in civil transportation, it is guided by several new sciences, special literature, scientific research, and educational institutions, and is served by a young but already well-established industry. It is strange to remember and to realize that only 30 years ago all this was not in existence. World aviation was represented by a few individual pioneers who were pushing the new art of flying ahead against considerable odds. A modern engineer would have difficulty in imagining the working handicaps of the pioneer pilot-designer of aircraft, who had to develop and build his machines with no reliable information available except the results of primitive, homemade research equipment, the study of the birds, and to a great extent the products of his imagination guided by intuition, knowing that an incorrect assumption or unfortunate guess might result in the loss of his flying machine and even of his life.

Comparing the modest performances of the early flying machines and the almost complete lack of reliable scientific data in 1908 with the present situation, we can realize the remarkable progress that has been made in the aeronautical industry and science during the short period of one generation. I believe it to be appropriate to mention these few ideas by way of a tribute to the work of pioneers in aeronautical science and engineering at a forum dedicated to the memory of an outstanding engineer who contributed greatly to the progress and development of one of the most important of modern industries.





Essentially full text of the twelfth Steinmetz Memorial Lecture delivered under the auspices of the Steinmetz Memorial Foundation at a meeting of the AIEE Schenectady, N. Y. Section on March 3, 1938.

IGOR I. SIKORSKY is a native of Kiev, Russia, and received his technical training at Petrograd, Paris, and the Polytechnic Institute at Kiev. In 1908, at the age of 19, he built his first aircraft, a helicopter. In 1910 he started building airplanes, and the following year two of his ships flew as long as one hour and reached an altitude of 1,500 feet. From then on he gained recognition, receiving awards in aviation exhibitions and competitions. He foresaw the necessity of large, multimotored flying ships and built the first successful one. Until 1917 he built planes for the Russian government, and following the revolution he was in France where he was commissioned to build planes for the French government. In 1919 he came to the United States, and later formed the Sikorsky Aero Engineering Corporation. This organization and its successor built single-motored and multimotored planes for commercial transport and government use. The first successful amphibian was developed in 1927. In 1929 the Sikorsky company and the United Aircraft and Transport Corporation were merged and the present factory built at Bridgeport, Conn.

the velocity of this airplane would be reached by a falling body, a drop from about 6,400 feet would be necessary, again disregarding the resistance of the air.

Such speed cannot be expected to be introduced in practical operation within the near future. The operating speed of the latest types of modern air transports, which is about 200 miles per hour for a landplane and about 160 miles per hour for a long-distance flying boat, is already very satisfactory. This speed is respectively about four times faster than the best railroad train from point to point, and six to seven times faster than the latest steamship. While this appears to be sufficient to justify travel by air, yet a further increase in operating speed must be expected, although a very high speed would be uneconomical and in many respects inconvenient. Practical considerations probably will limit the operating speed to a figure between 200 and 300 miles per hour during the coming decade. A certain increase in speed may be expected from operating at high altitudes. This factor will be discussed in greater detail in connection with stratosphere flying.

The table of the speed records established by airplanes shows that the greatest velocity of flying was increased more than nine times during the last 30 years. In line with this, various predictions have been made that in the coming 25 years velocities in excess of 1,000 miles per hour could be expected at low or high altitudes. In view of the present knowledge of aeronautics, this does not appear to be the case. Recent investigators have discovered that a great change in the character of streamline flow around the wing occurs when the speed reaches or approaches the velocity of sound, which is about 760 miles per hour at sea level. The adverse effects begin to be pronounced even at much lower speeds, usually around 500 miles per hour. The disturbance of the flow results in a considerable increase in the resistance of the moving body. Because flight above 400 miles per hour will necessitate expenditure of considerable power even under the best possible conditions of streamline flow, and because propeller efficiency has a tendency to fall off when the velocity of 500 miles per hour is exceeded, this speed may prove a practical limit for a substantially long time. Although extreme engineering effort and further research possibly may improve these figures, it appears quite certain that the present greatest speed will not be doubled unless new methods of generating power which permit the utilization of much greater energy within a given size and weight of airplane become available.

Altitude

The present world altitude record, established in 1935 by Captain O. A. Anderson and Major A. W. Stevens in a stratosphere balloon, is 72,395 feet. During this outstanding flight, which was sponsored by the National Geographic Society and the United States Army Air Corps, the aeronauts reached an altitude at which about 95 per cent of the mass of air was below them and only some five per cent of the air, highly rarefied, separated them from the mysterious depths of the interplanetary space. From this altitude they could observe and photograph the curvature of the earth. They were able to bring back a rich cargo of scientific data relating to air pressure, temperatures, electrical conductivity, cosmic rays, and infrared photography.

The highest altitude reached by an airplane is 51,361 feet, which was achieved by Mario Pezzi of Italy in a Caproni plane on May 8, 1937. The practical altitude of transport flying at the present time is limited not by

Table I. Speed Records

Date	Place	Pilot	Speed (Miles per Hour)
1909	France	Curtiss	47
1919	United States	Rohlfs	162
1929	England	Orlebar	357
1934	Italy	Agello	441

the characteristics of the machine, as it was a few years ago, but chiefly by the ability of the occupants to withstand the effects of the rarefied air. Therefore, although most of the modern airliners could exceed altitudes of 20,000 or even 25,000 feet, the flight operation is limited to an altitude of not over 12,000 or 15,000 feet. The normal pressure at sea level is 2,116 pounds per square foot. It may be safe to consider that a person of any age in reasonable health may stand without discomfort an altitude at which the pressure and density would be about two-thirds of the normal. This would be at an altitude of 10,500 feet. According to the condition of physical health, difficulties would begin at an altitude that would bring the pressure somewhere between two-thirds and one-half the normal. Below one-half the pressure and density, the living conditions would be hard and detrimental to nearly every human being. A pressure of one-half the normal occurs at 18,000 feet; therefore, for flights above this altitude, air conditioning definitely becomes necessary. Although physically strong people may stand this and even higher altitudes by breathing oxygen, this is not convenient for general use and the best way would be to supercharge the cabin and to maintain conditions of satisfactory temperature, pressure, humidity, and chemical content by artificial means. Therefore, for carrying passengers at high altitude, all these conditions must be created artificially in a satisfactory and reliable way.

Power-plant requirements for high-altitude flying involve a series of independent, important problems. The major of them is the supercharging of the engine itself, which means that an air compressor of adequate power must be combined with the engine and must supply air under pressure in the intake manifold so as to maintain sea-level conditions. After this is done, it becomes possible to maintain the desirable engine power at much higher altitude as long as the supercharger will supply air under the necessary pressure. The other problem is that of cooling. Although at high altitude the air is generally very cold, the loss of efficiency of the cooling system produced by the low density of air is much greater than the

gain resulting from the low temperature. Another difficulty is with the gasoline supply. The low pressure outside is liable to reduce the boiling point of the fuel to such an extent that rapid evaporation may result in a great loss. To prevent this, pressure must be maintained in the gasoline containers, which necessitates much heavier tanks and in general is undesirable. Still another problem is connected with the propeller. It is easy to realize that the propeller that will be satisfactory in size and diameter for operation at sea level conditions cannot be the proper one for flying in air of considerably reduced density. According to the conditions, part of the efficiency at low or at high altitude must be sacrificed or a compromise made.

In spite of the difficulties that are outlined, the construction of a practical stratosphere aircraft is now a routine engineering problem that can be solved, but it will increase the weight of the aircraft, as well as its cost and the expenses of operation. Therefore, although there is no doubt that high altitude aircraft will be built and introduced in service in the very near future, only practical experience will determine how large a fraction of the total air traffic will go in the stratosphere.

These requirements necessitate the development of what is called a stratosphere airliner, an airplane with an enclosed airtight cabin properly supercharged which will permit compressing the air and maintaining reasonable internal pressure that will make the conditions comfortable for the occupants. It is generally accepted that the air pressure that would correspond to an altitude of from 8,000 to 10,000 feet is satisfactory and the problem for the designer, therefore, becomes to supercharge the cabin to such an extent so as to create such conditions. That would mean that if an aircraft were to be operated at an altitude of 25,000 feet, the pressure of the air outside would be 785 pounds per square foot, while inside it would have to be maintained at 1,572 pounds per square foot. These figures disclose that the problem of supercharging the cabin is not an easy one because every square foot of the cabin would have to withstand a pressure of 787 pounds; therefore, any window of average size would have to withstand one or more thousand pounds, while even the minimum-size door would have to withstand a pressure of 12,000 pounds. The difficulty would be greater if a still higher operating altitude were to be maintained. The airtight cabin must be made very reliable because a quick loss of pressure created by a broken window or similar damage would involve serious results even at 25,000 feet and would most probably be fatal to everyone on board at 35,000 feet or higher.

After discussion of the difficulties, a brief study of the advantages offered by the operation of aircraft at high altitudes appears desirable. They are, mainly, a certain increase in speed and the possibility of flying above most or all of the major weather disturbances. With reference to the increase in speed, there is no general rule that could be applied to determine all cases. The cruising performance of an *S*-43 amphibian at various altitudes calculated on the basis of using a constant power of 540 brake horsepower from each of the two motors is as follows:

Altitude in thousands of feet	0	10	20	30	35	40
Cruising speed (gross weight 20,000 pounds)	160	175	189	204	210	210

This may serve as an illustration of a particular case. In other cases, the variation of speed may be greater or smaller according to the characteristics of the aircraft.

Still more attractive is the other advantage, namely, the possibility to fly always in clear air above thunderstorms, fogs, and ice formations. Although bad weather in general is no longer a source of danger, operation in the always clear and reasonably smooth upper atmosphere would add to the comfort and to the accuracy of schedule which is very important. With these advantages and the possibility of approaching and eventually exceeding speeds of 300 miles per hour, without the use of excessive engine power, a real service test of airline operation at high altitudes is very desirable and can be expected in the near future.

Besides its application for air transport, high-altitude flying in itself presents substantial interest from a military and scientific standpoint and it appears proper to discuss briefly what can be achieved in this direction. There is no doubt that present altitude records will be substantially exceeded with further progress in the design of aircraft and their power plants. The evidence on hand, however, appears to indicate that somewhere between 75,000 and 100,000 feet may be the limit of altitude which most probably will not be exceeded by an airplane driven by an internal combustion engine and propeller. The reason for this is briefly as follows.

An airplane with cabin superchargers and all necessary equipment can hardly be produced so as to have an economic speed of less than 50 miles per hour at sea level. Even this speed would necessitate very light wing loading and therefore proportionately large wings. At the ex-

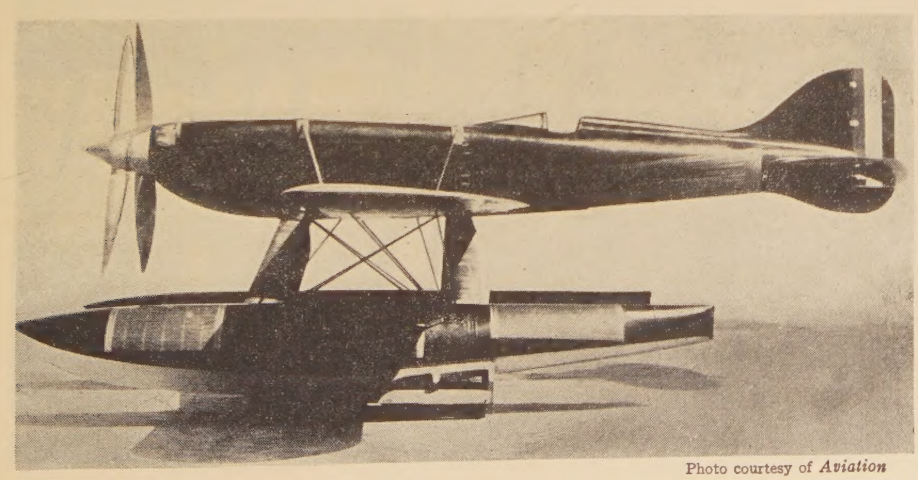


Photo courtesy of *Aviation*

Macchi Seaplane which, with 3,500-horsepower Fiat power plant, set a world's speed record of 440.681 miles per hour on October 23, 1934

treme figure of 100,000 feet, the density of the air is found to be about one one-hundredth of that at sea level, which means that it would be necessary to fly ten times faster or about 500 miles per hour to stay in the air at this altitude. This speed is too high for the efficient operation of the wings. Besides, the operation of a propeller with any satisfactory efficiency cannot be expected if such a great difference in density is experienced. Therefore, it is probable that an altitude of from 75,000 to 90,000 feet and a speed of from 500 to 600 miles per hour will not be exceeded until a new source of energy giving greater power per unit of weight, combined with a new method of propulsion, becomes available.

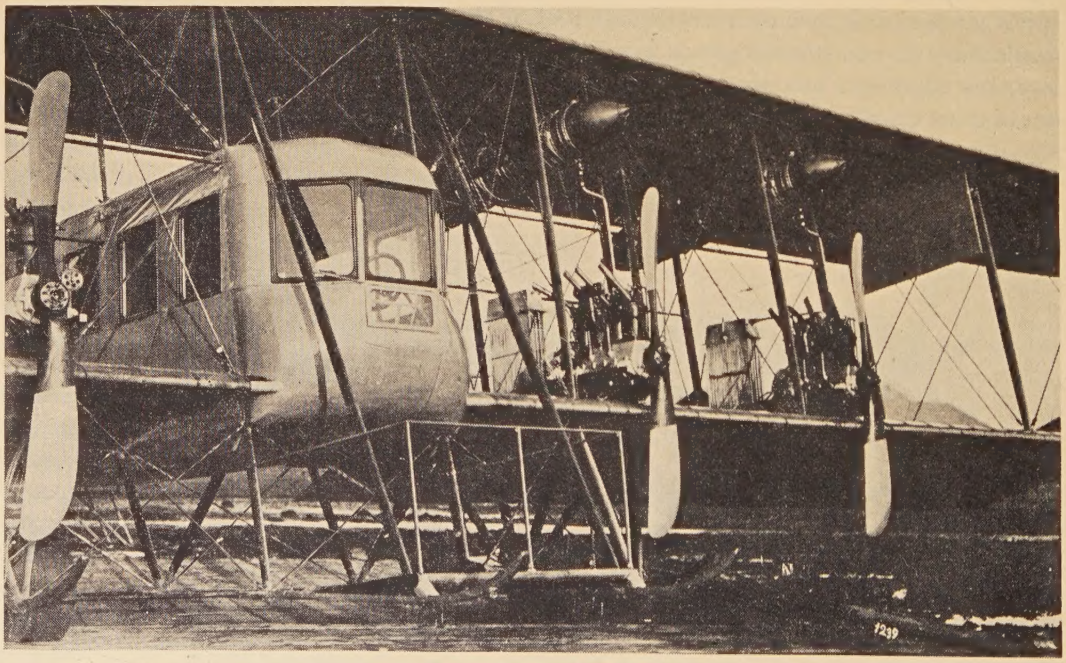
Size of Aircraft

Just 25 years ago, in March 1913, the author was finishing the Sikorsky *S*-21, the first four-engined airplane, which had a gross weight of four and one-half tons and an enclosed cabin for eight passengers. At that time the plane was much larger than any other in existence and was usually considered as too heavy to be able to fly or at least to be practical. The *S*-21 was completed and during the spring and summer of 1913 made many successful flights, demonstrating for the first time the advantages of the large size and multiple power plant. In February of the following year, the *S*-22, another four-engined airplane with a gross weight of five tons, took off with 15 passengers on board, establishing a world record which remained unsurpassed for several years. Since then these figures have been exceeded considerably and at the present time there are several successful airplanes from five to ten times larger and heavier than the modest machines that were mentioned. A Sikorsky *S*-42 transoceanic flying clipper ship, powered by four 750-horsepower engines, is shown at the head of this article. Further to this, a brief study may be made with reference to the largest possible size and weight of future aircraft.

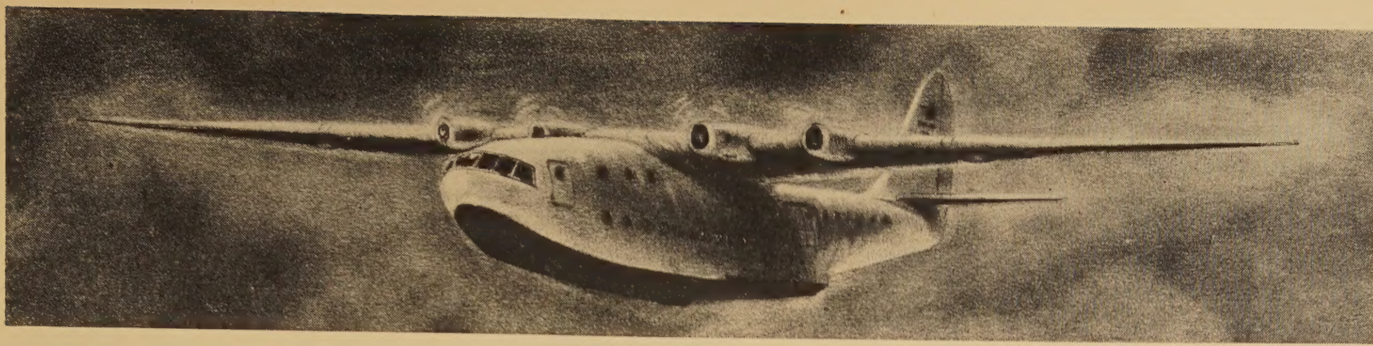
Not long ago there was a great difference of opinion on this subject and many well-informed observers in aeronautics, as well as in the field of science in general, expressed the opinion that with the increase in size, airplanes would lose load-carrying efficiency and finally would even be unable to fly. It was mentioned that nature could produce birds of only a limited weight and when the ostrich exceeded a certain weight it proved too heavy to fly. While this illustrates the case, a scientific and at first glance indisputable explanation was furnished by the so-called law of squares and cubes, which means that when an object is proportionately enlarged the surface will increase as the square, while the volume and therefore the weight will increase as the cube of linear dimensions. This would mean that the structural weight would increase more rapidly than the ability of the aircraft to carry load because the latter depends on the wing area. The limitations in possible size estimated on the basis of this rule, however, were exceeded time and time again and the larger airplanes, contrary to predictions, proved to be the more efficient ones.

The general situation in this respect can be briefly ex-explained as follows. The law of squares and cubes would really condemn a heavy airplane if the latter were to represent a true enlarged copy of a small machine, which as a general rule would be the wrong way to design it. If, however, the plane is correctly studied and the advantages of the large size are properly utilized, greater transport efficiency may be obtained in the larger plane. In simple language, this means that if ten tons of payload were to be transported 3,000 miles, one single airplane would do it faster with the same amount of fuel or would require less fuel for the same speed than would ten smaller planes carrying one ton each.

Space does not permit a study of this question with more details, but in general the opinion of the author is that the limit in the size of aircraft in the future will be dictated not by engineering possibilities, but by economic factors and traffic requirements. Travel by air is essentially a fast method of communication which requires frequent departures in order to be really useful. It is not unreasonable for a passenger or a letter to wait three days



Sikorsky "Ilia Mouremetz" airplane in February 1914; this multiengined craft weighed five tons and carried 15 passengers



Artist's conception of a future transoceanic flying boat

for the departure of a steamer which then would take about one week to cross the Atlantic. If a passenger or a letter were to wait for three days and then cross the ocean in 18 hours in a plane, the long waiting would defeat or at least considerably reduce the value of air service. To make the latter efficient and valuable, daily departures across the oceans and still more frequent schedules across the continent are necessary.

Another factor that will influence the size of the aircraft is the extreme operating efficiency of the airplane for carrying passengers. If, for instance, we compare a transoceanic steamer carrying 2,500 passengers with airliners carrying 100, we may at first think that 25 planes are needed to do the service of one steamer. Actually, however, the steamer will make one trip during a week, while the planes would make at least five trips each; therefore, five airliners carrying only 100 passengers each could replace a large steamer. It appears then that the speed and efficiency of the airliner as a passenger carrier would place a practical limitation on the size long before the engineering possibilities would be exhausted.

This being the case, it does not seem necessary to renew the old argument about the technical limitations of the size of the aircraft of the future. That flying boats of 500 or even 1,000 tons carrying several thousand passengers, could be successfully designed and built is the personal belief of the author; however, for the reasons just discussed, a larger number of ships of from 100 to 250 tons with frequent departures will render better service and will remain the backbone of the intercontinental flying fleet during the next 25 years. The land transports will probably remain substantially below this tonnage because the size of airports, difficulties connected with the use of too big landing gears, and finally general advantages of frequent schedules will place a limitation probably between 50 and 100 tons, on the practical size of land transports for the coming quarter of a century.

The 100-ton transoceanic flying boat is, however, the prospect of the immediate future. Within a few years passengers will travel to Europe on such ships that will cross the Atlantic in less than 20 hours. The flight will be luxurious and pleasant. There will be some 50 comfortable staterooms, a large dining salon that will be used for dancing or games in the evening, promenade decks, smoking lounges, a library, comfortable living quarters for the crew and in general most of the accommodations and luxury items found on board a first-class yacht, except only the swimming pool.

The design of such ships would include many novel engineering problems. The manual power of the pilot would be inadequate to operate the control surfaces of the 10,000-horsepower flying ship. Therefore, the controls would have to be operated mechanically. Powerful engines, as well as numerous auxiliary mechanisms, usually would be located inside the huge wings in special engine rooms under the supervision of mechanics. There would be a supercharging plant, an electric power plant, and a heating plant to maintain comfortable temperatures while the ship is cooled by the 200- to 250-mile-per-hour wind while flying at −60 degrees Fahrenheit in the substratosphere. There would be a long list of other important items and auxiliary mechanisms.

Such problems, however, are now routine engineering work. It will be done in the near future and the new superclipper ships will bring luxury and regularity in transoceanic service. Flights to Europe in from 15 to 18 hours, with Asia or Australia on the second day, and three- or four-day round-trip cruises from New York to the North Pole or to the Amazon River jungles, may be expected to be well in operation before 1950.

Such appears to be the general outlook of some of the aspects of aviation of the near future. The ideas expressed are mostly personal and are believed to be rather on the conservative side. They are based on present scientific information, and on the use of existing power plants and materials as well as on methods of design and construction. A new discovery in aeronautical or even in general engineering may involve a substantial revision. For instance, if a method of safe and economical production and handling were developed for the use of liquid hydrogen as a fuel, a great change would result particularly with respect to long-range aircraft. This would make possible the circumnavigation of the earth along the equator in a nonstop flight without refueling. It would also enable an increase in the performance of nearly every type of aircraft. Other discoveries of similar or of different and possibly unexpected nature may indeed change substantially the outlook that was presented. However, even if it remains within the "program minimum" that was outlined, the immediate future of flying presents a bright and interesting picture and shows that aviation is quickly becoming a major and influential factor of progress.

New 98-Inch Continuous-Strip Steel Mill Opened at Cleveland

IN THE competitive struggle of steel manufacture, the modern tendency is toward the adoption of bigger, faster, and more efficient machinery. In point of size, a new 98-inch strip mill recently placed in service by the Republic Steel Corporation at Cleveland, Ohio, now dominates the field. Recent improvements in lubrication, hydraulics, welding, design of bearings, and electrical control have been embodied in the design of the new mill to make possible the production of extra-wide sheet steel at an exceptionally high speed. Maximum delivery speed of the hot mill is 2,121 feet per minute. It can roll all finished widths from 30 to 94 inches and all finished thicknesses from 18-gauge strip to one-half-inch plate. The plant has a rated capacity of 70,000 gross tons per month.

The mill is located on a 182-acre site six miles from the mouth of the Cuyahoga River. For a distance of almost half a mile at this point the river itself was moved to make way for the mill, more than 1,000,000 cubic yards of earth being moved in excavating for the new river channel and in filling the old river bed and a nearby swamp. More than 19,000 concrete piles averaging 40 feet in length were driven into the new fill and 120,000 cubic yards of concrete were poured to provide a foundation for the superstructure and the heavy mill equipment.

The total electric power demand of the entire mill is 20,000 kva. Three-phase 60-cycle electric power supplied by the local utility company is conducted directly to the strip mill motor rooms through an underground duct system at 11,000 volts. Both alternating and direct current, at voltages of 2,300, 600, 440, and 250, are required by the mill's electrical equipment. For the hot-mill finishing stands and the cold-reduction-mill stands, direct current is supplied at 600 volts by four 6,000-kw motor generator sets. For the roughing-mill main-drive motors, general-service water pumps, spray pumps, and air compressors, energy is supplied at 2,300 volts from a 12,000-kva transformer bank. The 250-volt d-c supply is obtained from three 1,500-kw motor generators driven from the 11,000-volt service. For lighting and auxiliary motors throughout the plant, a 3,000-kva transformer bank reduces the voltage to 440. To save on length and cost of interconnections between these transformers, switchgear, and motors, the transformers are of the noninflammable, nonexplosive type and are located in the motor room proper.

The hot mill requires almost 40,000 horsepower for main-drive motors alone. The roughing-mill main-drive motors are 3,000-horsepower, a-c wound-rotor motors controlled by slip regulators. Three of them are provided with heavy flywheels and are automatically controlled to smooth out the peak loads. Main-drive motors of the first five finishing stands are 4,500-horsepower adjustable-speed shunt-wound d-c motors, bus controlled by the Ward Leonard system. The last finishing stand is driven by a 3,500-horsepower motor of the same type.

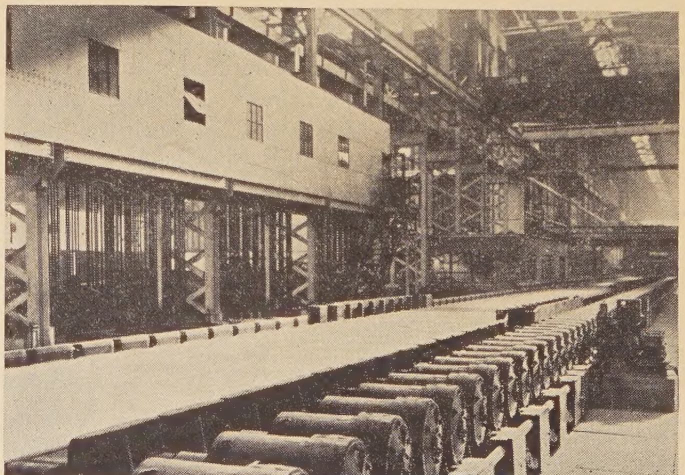
Altogether the mill contains 1,420 motors with a total rated capacity of 123,000 horsepower; 58 motors are rated at 100 horsepower or more, and of these, 23 are rated at 1,000 horsepower or more.

Republic's new strip mill is said to be the first ever designed with run-out tables and coilers driven by individual d-c motors instead of a-c motors. The operating requirements of these tables are severe, for the rollers must start from rest, accelerate to a high speed, decelerate, stop, and reverse in a very short time. These d-c motors, which are totally enclosed, shunt wound, of the ball-bearing type, are used in sizes of 4.5 horsepower or less on table rollers, and 25 horsepower or less on coiler rollers. The use of d-c motors foregoes the conversion losses of d-c to a-c motor generator sets, simplifies the control apparatus, and saves substation space because control equipment is compact and the number of motor generators is reduced. Only two 1,000-kw motor generator sets are required for the d-c run-out and coiler motors.

The hot-mill motor room, which is 576 feet long by 65 feet wide and houses five of the seven motor generator sets and all the hot-mill main-drive motors, is said to house the largest concentration of electrical rotating machinery (in horsepower per square foot) of any industrial plant ever built. All equipment is operated from one control desk in the motor room.

The oil circuit breakers connected to the 11,000- and 2,300-volt equipment are enclosed in metal-clad units located on the main floor of the motor room. Wherever possible, cable was placed in conduit and imbedded in concrete and, excepting overhead power feeders for general service, is lead covered.

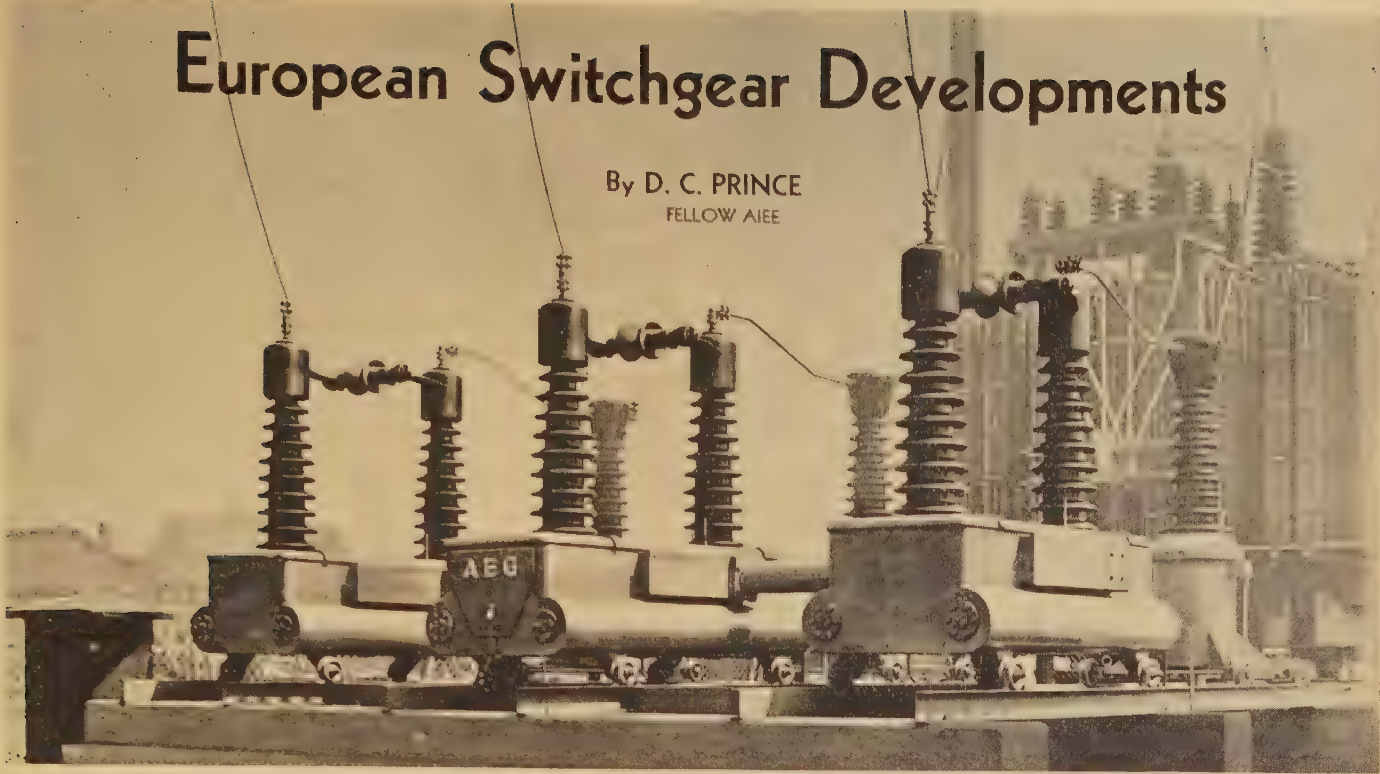
Illumination is supplied by about half incandescent lamps and half high-intensity mercury-vapor units, which are alternated throughout the mill. A minimum intensity of 7 foot-candles has been provided, with 15 foot-candles being used generally throughout the mill. For the mill buildings proper the lighting load is approximately 900 kw.



The runout-table rollers of Republic's 98-inch strip mill are driven by 278 d-c motors

European Switchgear Developments

By D. C. PRINCE
FELLOW AIEE



AN electrical engineer visiting Europe is immediately struck by the wide differences in design of switchgear compared to familiar practices in the United States. In England, metal-clad gear is nearly universal except for the highest voltages and even at 132 kv there are metal-clad gears. On the Continent there are almost no metal-clad gears. This does not result in any similarity between Continental stations and American open switching stations with their rows of tank-type circuit breakers. In France some tank-type oil circuit breakers still are being installed but a variety of different designs are appearing, while in Germany the tank-type circuit breaker may be said to be altogether obsolete.

This transformation has been going ahead with increasing momentum for about ten years. Many causes doubtless contribute to it. The supply of oil alone is a serious factor in countries like Germany and Italy which must import every drop of the precious liquid. Steel also is scarce in these countries and must be conserved where possible. Angry clouds of war never seem to draw below the horizon and extra tank cars of oil at vital distribution centers might furnish unnecessarily vulnerable targets.

These reasons would not apply to the United States perhaps with the same force but there are others. The oil circuit breaker has had a long and honorable service record here. Since the introduction of powerful testing plants, the reliability of operation under fault conditions has been greatly improved. Early foreign designs tested in the United States have appeared less rugged and their behavior has been correspondingly less impressive. The frequency and seriousness of circuit-breaker failures abroad is not known but the situation has been serious enough to excite governmental bodies and fire underwriters in Germany, at any rate.

Three years ago American engineers listened to this story with the attitude, "It can't happen here." Since then three major system shutdowns have occurred, not the result of oil-circuit-breaker failures, but involving soot from oil to greater or less degrees. They have, therefore, reached a crossroad. A check must be made to determine whether their instrumentalities are the best for their conditions or whether they can learn anything to their advantage from European practice.

This problem is much more serious in the United States than in Europe. The very standard of living is based on a measure of uniformity in practices. Americans wear mass-production clothing, eat mass-production food, ride in mass-production automobiles, and sleep under mass-production roofs. They cannot enter lightly upon a program of making every circuit breaker different from every other circuit breaker without a certainty of increasing costs on the already groaning utilities. It is with this in mind that European switchgear developments have been studied to see if a change in course is called for and, if so, whether there is any escape from the condition of chaos which exists there. Views on European circuit breakers seem as varied as views on politics. Calm analysis should be possible in engineering even where it is not possible in the social field.

Written especially for Electrical Engineering, based on an address presented before the AIEE Philadelphia (Pa.) Section, November 8, 1937.

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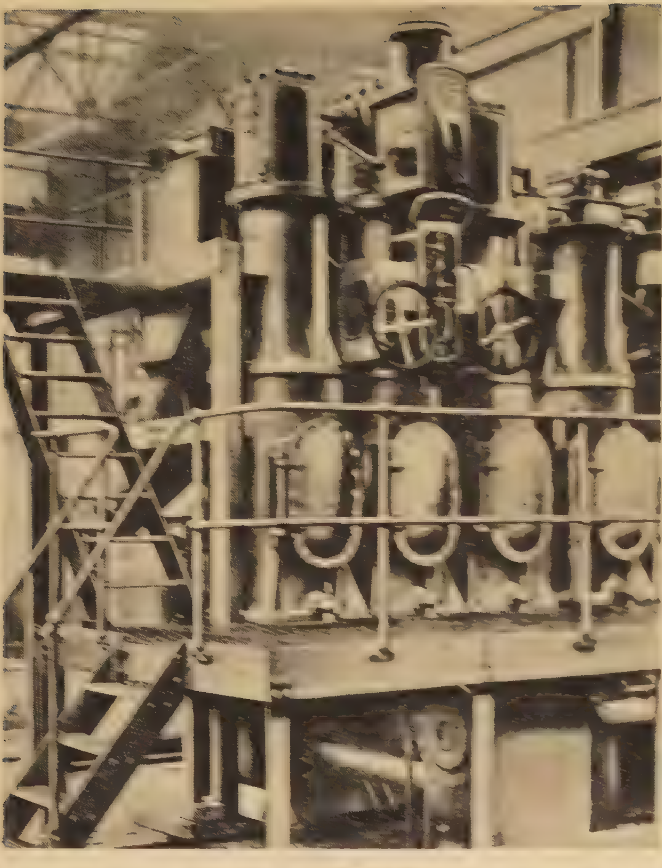


Figure 1. Front view of Metropolitan Vickers metal-clad switchgear, employing single-break circuit breaker—33 and 66 kv

England, France,

There is a very pronounced difference between switchgear practices in England and on the Continent. In England the general trend has for years been in the direction of metal-clad gear, while on the Continent, both indoor and outdoor structures are largely open.

In England for some years the tendency was to make enclosures continually stronger and larger, and this development resulted in some very large and heavy gears for the higher voltages such as 33 and 66 kv. The earlier gears, in general, were of the plug-in type in which a circuit breaker was either elevated or rolled into position so that its bushings plugged into corresponding receptacles in the bus structure.

In the new gears, especially at the higher voltages, the trend appears to be away from air plug-in gears altogether; and in the direction of a gear in which the disconnecting switches are of a more or less conventional type immersed in oil. The development also includes special circuit breakers designed to be a part of metal-clad gear. One example of this kind is shown in figure 1, which is a Metropolitan Vickers gear built for 33 and 66 kv. The circuit breakers have a single-break explosion chamber enclosed in a metal cylinder. A section of such a gear is shown in figure 2. It has a single break and a Metropolitan Vickers explosion chamber arranged in the center of a vertical steel tube. The ends of this tube are blocked off to separate them from the disconnecting switch compartments. Bushings passing through these barriers carry bushing-type current transformers. The circuit breaker is thus an integral part of the gear. Maintenance is carried on in place by first isolating the circuit breaker through its disconnecting switches, after which the oil is drawn off and the manhole cover removed, giving access to the interior.

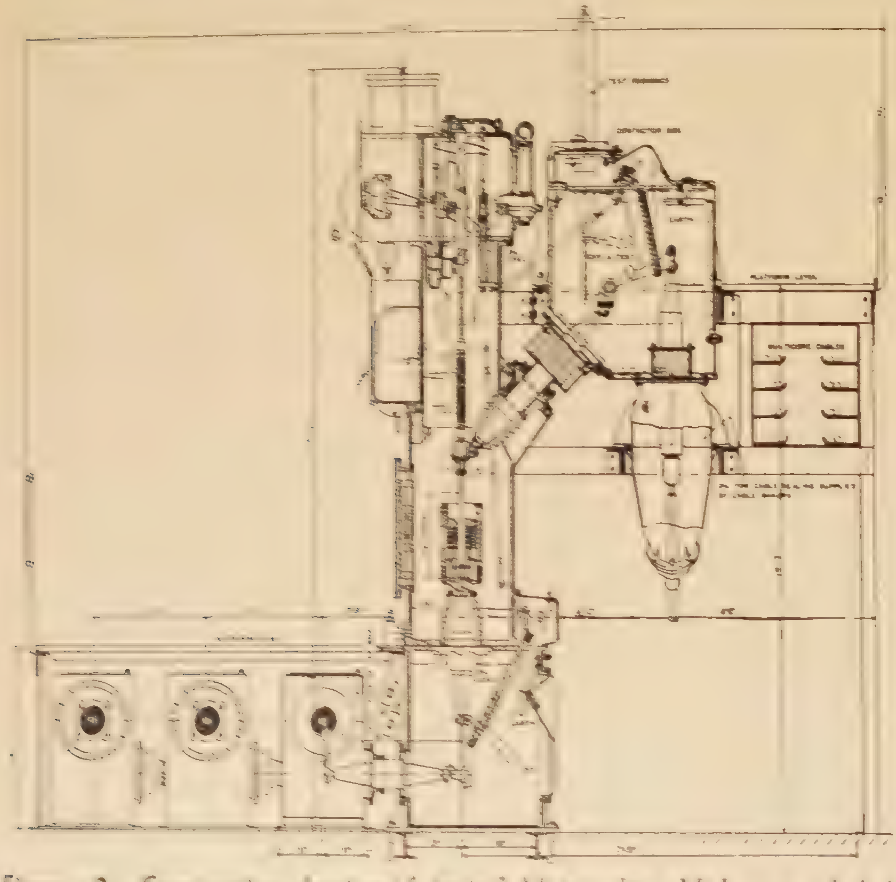


Figure 2. Cross-section drawing of typical Metropolitan Vickers metal-clad gear, single-bus layout

In France, and for that matter everywhere on the Continent, metal-clad gear has made very little progress. The general trend is away from the conventional tank-type breaker as American engineers know it, and a large variety of alternative designs is being tried.

Figure 3 shows a low-oil-content breaker by Als-Thom. A single explosion chamber per phase is depended upon, located in a Herkolite tube, which is in turn surrounded by porcelain weather protection. Access to the contacts is obtained by raising the cover. Drawing off the oil is not necessary, so that inspection and maintenance work can be carried on in a very few minutes with a minimum of difficulty.

and Sweden

Breakers of this type have been made, employing an explosion chamber similar to that developed by Metropolitan Vickers, although more recent designs bear more resemblance to the oil blast with its intermediate floating contact.

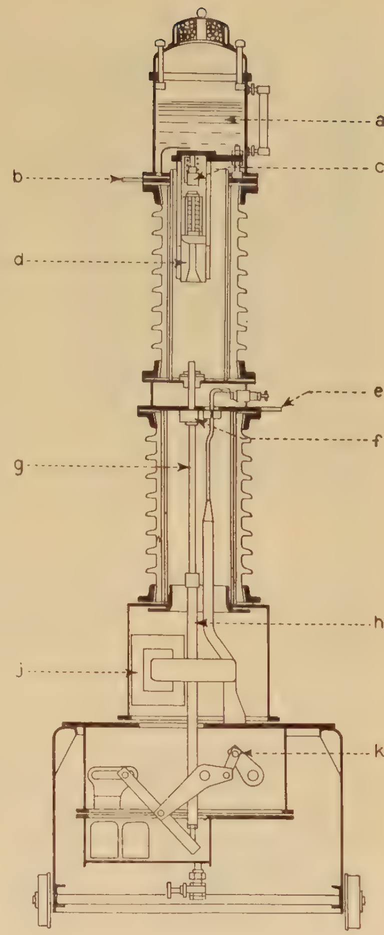
In the high-voltage-breaker field, the general arrangement shown in figure 3 is employed by a number of companies, including Delle in France, Brown Boveri in Switzerland, and Siemens in Germany. For lower voltage, the Delle company in France has developed an air-blast breaker shown in figure 4 in which the arc is transferred by the air blast to a circuit containing resistance, the function of which is to reduce the current and bring it nearer to unity power factor for ease of interruption. Als-Thom in France, Brown Boveri in Switzerland, and AEG in Germany all make circuit breakers of the air-blast type, but this resistance feature is peculiar to the Delle design.

Figure 5 shows a Delle breaker in which the pressure is supplied by a piston. The capacity of this design is limited, since only a moderate amount of air can be supplied by a reasonably powered mechanism.

Figure 6 shows a low-oil-volume breaker recently announced in Sweden. It is interesting to note that whereas the Siemens company advocate the "expansion" theory of operation, the Swedish company has chosen to attribute the operation of its device to "contraction." Just how this difference is interpreted in physical structure is not known to the author.

Figure 3. Low-oil-volume circuit breaker (Als-Thom). An oil blast explosion chamber is mounted in a fibrous insulating tube, which is in turn enclosed by a porcelain weather - protection shell. Design provides a single break in oil

(a) Expansion chamber
(b) Upper (outgoing) terminal
(c) Upper fixed contact
(d) Extinguishing chamber
(e) Lower (incoming) terminal
(f) Lower fixed contact
(g) Moving contact
(h) Insulating rod
(j) Current transformer
(k) Mechanism



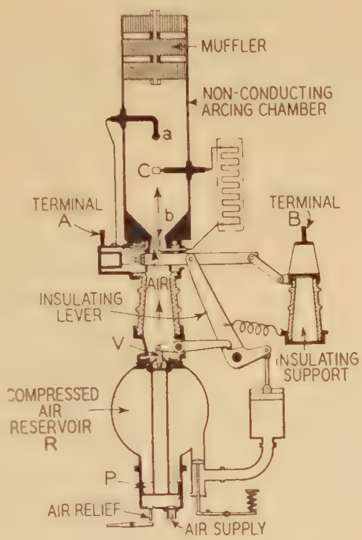


Figure 4 (left). Air blast circuit breaker (Delle). Air blast transfers the arc from the main contacts to auxiliary contacts in series with a resistance

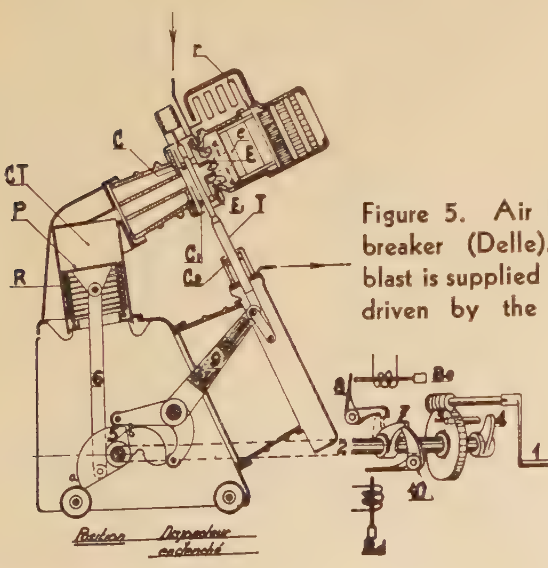


Figure 5. Air blast circuit breaker (Delle). The air blast is supplied by a piston driven by the mechanism

Figure 6. Low-oil-volume 220-kv oil circuit breaker, made in Sweden by Allmana Svenska Electric Company. A blast of oil is produced by a differential piston driven by arc pressure. Manufacturers have chosen to call it a "contraction" breaker in contradistinction to the "expansion" breaker made by another Continental firm

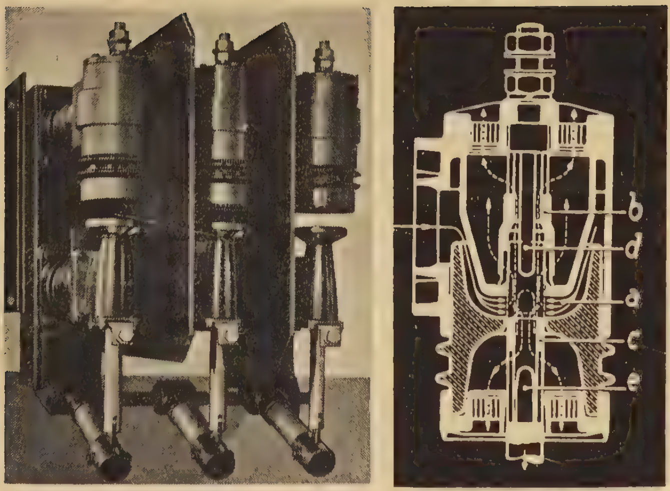


Figure 7. Air-blast breaker manufactured by Voigt and Haeffner. Air is introduced in the middle of the arc stream, which is then blasted in both directions as shown by the arrows

Figure 7 shows an air-blast breaker manufactured by Voigt and Haeffner. The distinguishing mark of this design is that air enters midway of the arc and blows against both electrodes, as compared with the single direction of motion in the more conventional types of air-blast design. A new AEG design will be shown a little later, in which this procedure is exactly reversed.

The lower-voltage design of expansion breaker developed by Siemens in Germany is shown in figure 8. The three explosion chambers, one per phase, contain a liquid called "Expansene" which has a water base for circuit breakers up to approximately 40 kv. It may be noted that the break is visible in the open position and that there are no surfaces exposed to the interrupting liquid across which the current can creep. A higher voltage and larger capacity design of expansion breaker is provided with a disconnecting blade which operates from the main mechanism and isolates the circuit breaker from the circuit in the open position.

Figure 9 shows a typical section of the expansion design particularly applicable to the higher-voltage ratings. A single-break-per-phase explosion chamber is employed for the lower voltages. This explosion chamber is made up of a number of parts held together by springs, so that the pressure is relieved at the higher currents.

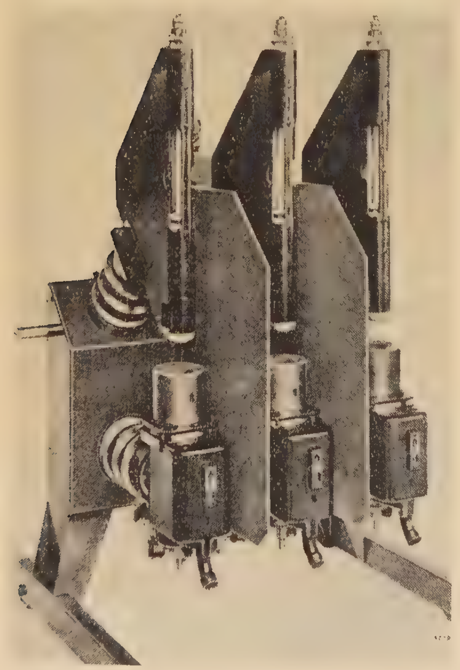
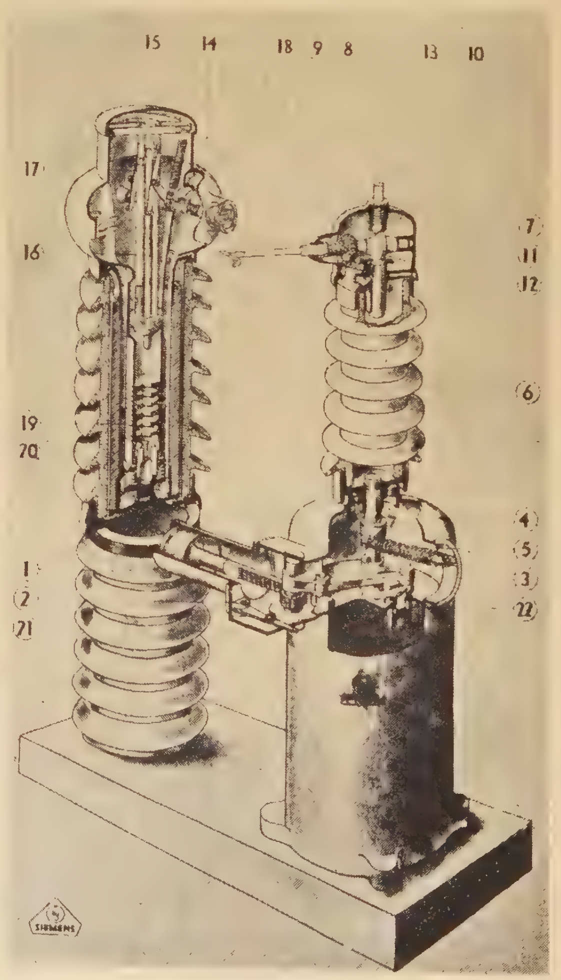


Figure 8. Expansion (water) circuit breaker manufactured by Siemens. Contacts are withdrawn completely from the expansion chamber, providing air insulation in the open position



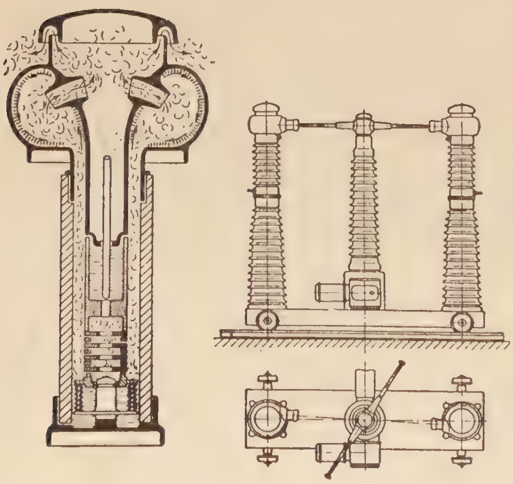


Figure 9. Diagrammatic sections of high-voltage expansion breaker manufactured by Siemens. Rotation of one column first withdraws the contact from the expansion chamber; further rotation withdraws the disconnecting blade, providing air insulation

For voltages higher than 40 kv the liquid used has an oil base instead of the water base; and for the highest voltages, two explosion-chamber units are arranged in series. The high-voltage arrangement is shown in figure 10. The upper section of each end column contains an explosion chamber. The rotating central column, besides providing a disconnecting function, is used to operate the explosion chamber contacts. A disconnecting blade engages a jaw coupling, and then rotates so as to operate the vertical contact in the explosion chamber.

AEG has advocated the use of a single air-blast type of circuit breaker throughout the entire voltage and capacity range. However, where small breakers are installed singly, it has been found that the necessary air supply constitutes an undue handicap, and the chemical resin breaker, figure 11, has therefore been brought out to fill this field. The structures resembling explosion chambers contain tubes of urea resin, which when exposed to the arc give off quantities of gas by which the arc is extinguished. AEG has also produced water breakers of the type shown in figure 12. An explosion chamber containing water is located in the center of each pole. Circuit breakers of this design are not now in production although some have been made in the past and are in successful operation.

The principal output of AEG is in air-blast circuit breakers of the type shown in figure 13. The construction of these is shown more in detail in figure 14*a*. Air is supplied through an electrically operated valve at the top of the air tank, both to close and open the breaker. For the closing operation, the air passes through the small pipe at the lower side of the operating piston. In opening, air passes through the large pipe at the upper side of the operating piston and also to the annular space surrounding the sliding contact *f*. As the contact pulls down, air rushes between the moving contact *f* and the stationary contact *h*, extinguishing the arc. The structure above the contact *h* is a muffler.

A more recent modification of this general design form is shown in figure 15. Here the circuit breaker is made somewhat more compact by relocating the tank, as shown. In these circuit breakers the main air valve for the arc-extinguishing air is controlled mechanically by a cam on the shaft, which operates the contacts. A sectional view of this breaker is shown in figure 14*b*.

Figure 16 is a typical outdoor design of the air-blast AEG breaker. The operating parts are similar to those shown previously, except that larger stroke is provided and that the porcelain weather shell surrounds the Herkolite tube.

Figure 10. Expansion breaker for 200 kv manufactured by Siemens, embodying two interrupting chambers mounted on current transformers. Operation and isolation are obtained by rotation of the central column

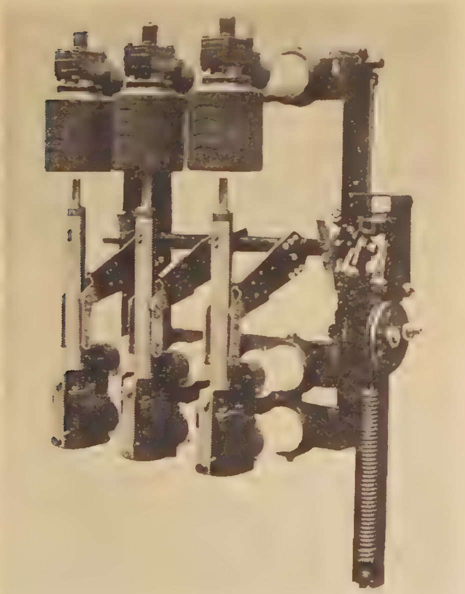


Figure 11. Compressorless gas-blast breaker manufactured by AEG. Contacts are separated within a tube of special resin; arcing evolves gas which interrupts the circuit

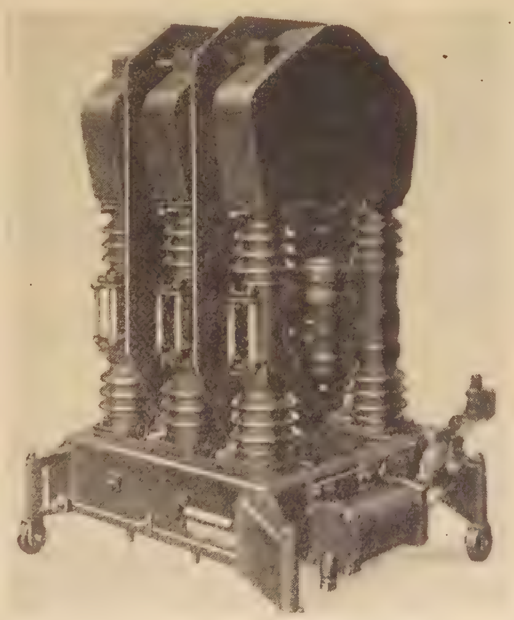


Figure 12. Water circuit breaker manufactured by AEG. This design is said to have given satisfactory service for many years although it now has been withdrawn in favor of gas-blast designs

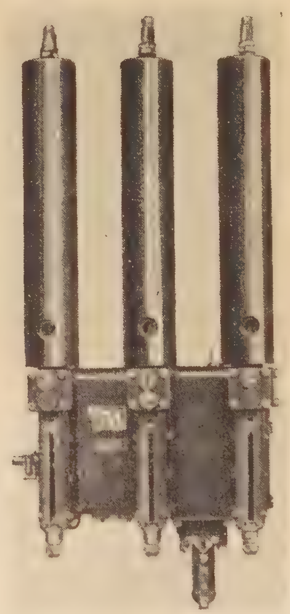
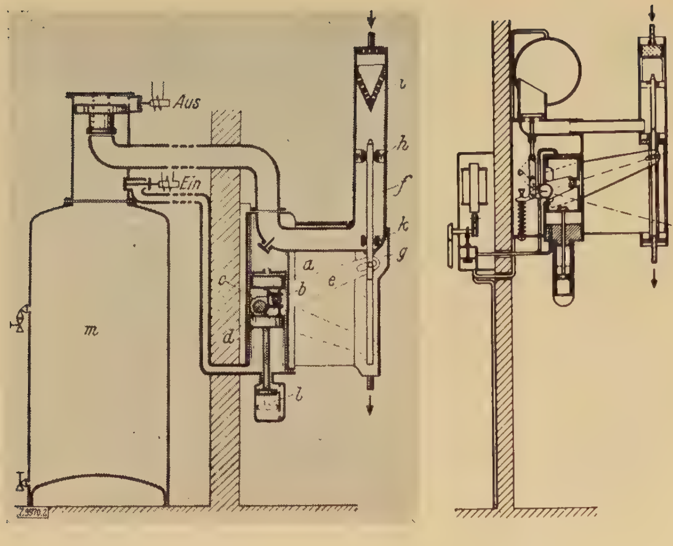


Figure 13. Low-capacity air-blast breaker (AEG). The largest number of air-blast breakers in service are of this type



(a) (b)

Figure 14. Diagrammatic sections of air-blast circuit breakers (AEG)

(a) Method of mounting with mechanism and all live parts on one side of a barrier wall with storage tank and control valves on the other side

(b) Corresponding mechanism and mounting of new design

Germany and Switzerland

chanical motion, which then continues, providing ample contact separation when the contacts return to their extruded position upon shutting off of the air supply. This exactly reverses the arrangement of the Voigt and Haeffner design of figure 7. This design seems to be a most happy arrangement for an air-blast breaker as the contacts are at all times visible, and inspection and maintenance work can be carried on with a minimum of dismantling. A three-phase unit of this design is shown at the head of this article; station height is established by the transformer in the background. Current transformers are mounted separately.

Brown Boveri of Switzerland has developed a characteristically different form of air-blast circuit breaker, shown in figure 18. Like the AEG design just described, the contacts are separated by air pressure against a piston. However, a separate set of disconnecting contacts is then operated by the same mechanical mechanism. As soon as the opening air pressure is shut off, the arcing contacts return to their original position, but isolation is maintained

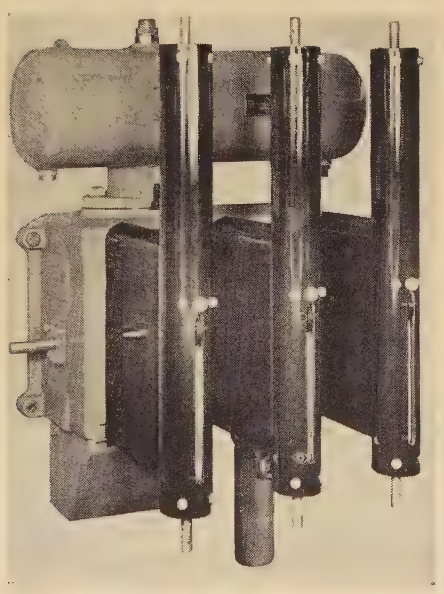


Figure 15. Latest design of indoor-type air-blast circuit breaker. This design is superseding that of figure 13

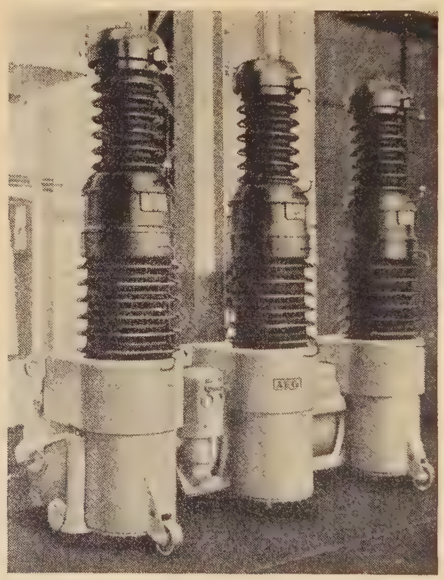


Figure 16. Intermediate-voltage air-blast breaker (AEG), design now obsolete

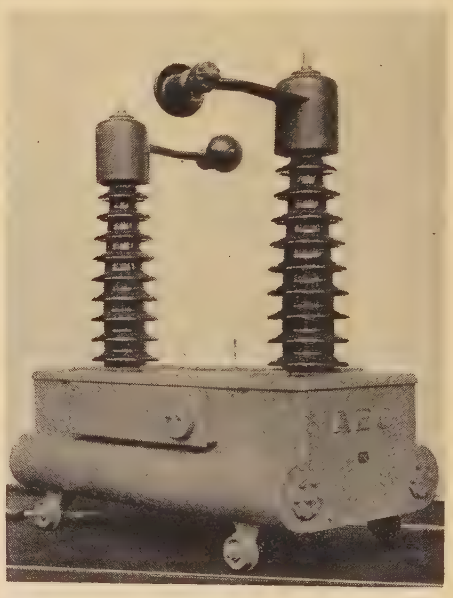


Figure 17. Single-pole 110-kv air-blast breaker of latest design (AEG)

A recent air-blast design is shown in figure 17. This consists of two vertical columns each carrying a horizontal arm with a contact at its end. The vertical columns rotate to separate the contacts. In opening, air is supplied through the center of each column, out through the horizontal arm to a piston attached to the contact. This piston draws the contact back inside the shield shown, which is made of insulating material. Air then passes out around the contact, through the hole in the shield. The two streams of air meet between the two shields. This operation takes place at the very beginning of me-

by the disconnecting contacts. Another arrangement of this breaker is shown in figure 19.

Higher-voltage Brown Boveri breakers follow the Als-Thom, Delle, and Siemens practice in general, and consist of single-break explosion-chamber interrupting elements incased in porcelain weather shells. Many of the circuit breakers of this general design contain current transformers in their bases. Others have separate current transformers.

Continental practice is quite different from American in that over-current operation is much more prevalent, and

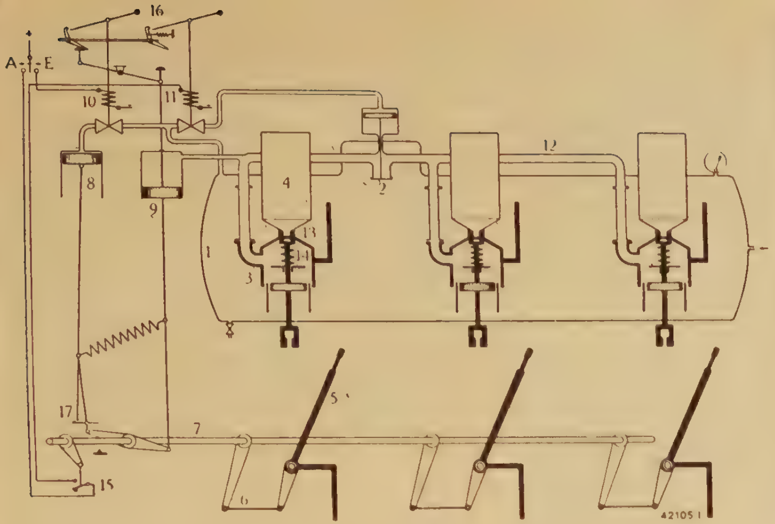
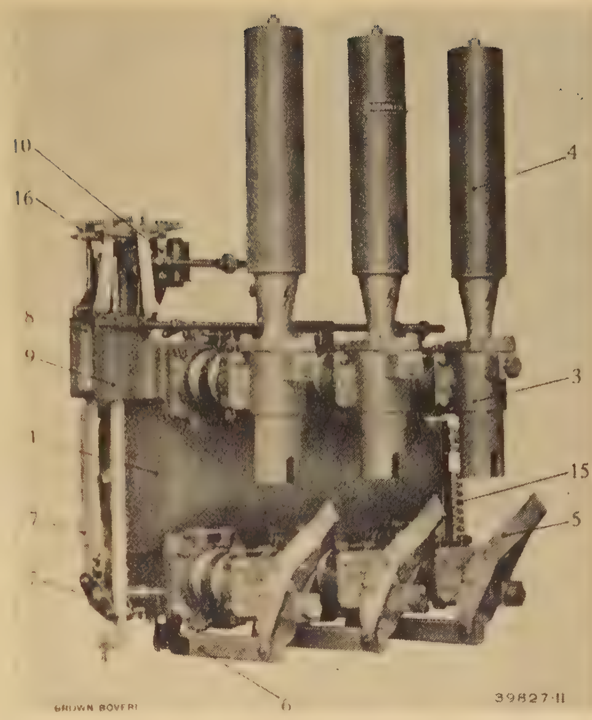


Figure 18. Air-blast circuit breaker manufactured by Brown Boveri (Switzerland)

Interrupting contacts are drawn back by air pressure operating on a piston. Disconnecting blades provide ultimate isolation. Interrupting contacts close by a spring as soon as the air pressure is removed



distance and balanced relaying much less prevalent than in the United States. For that reason the accuracy requirements on the current transformer are much easier to meet, a factor of considerable economic importance where this type of design is involved. Figure 20 shows a three-phase circuit breaker of this type and also a section of the explosion chamber which is reminiscent of the Siemens design.

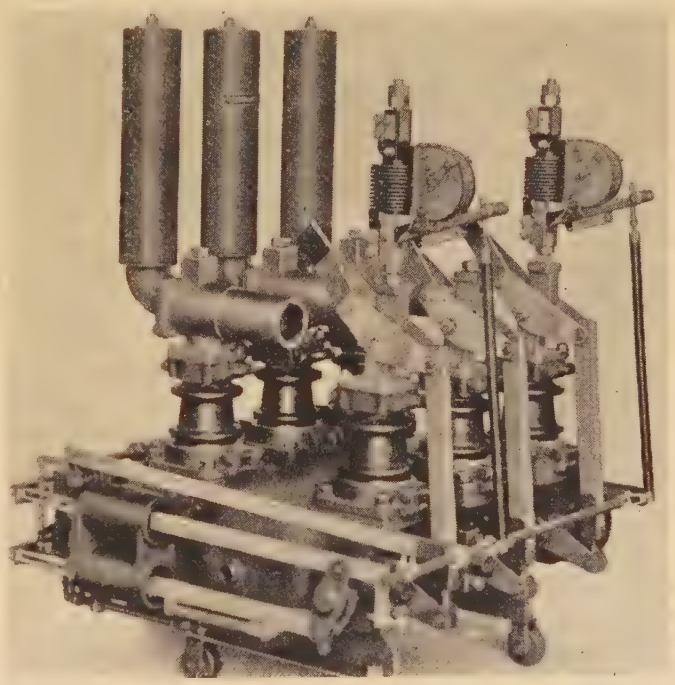


Figure 19. High-voltage air-blast circuit breaker (Brown Boveri)

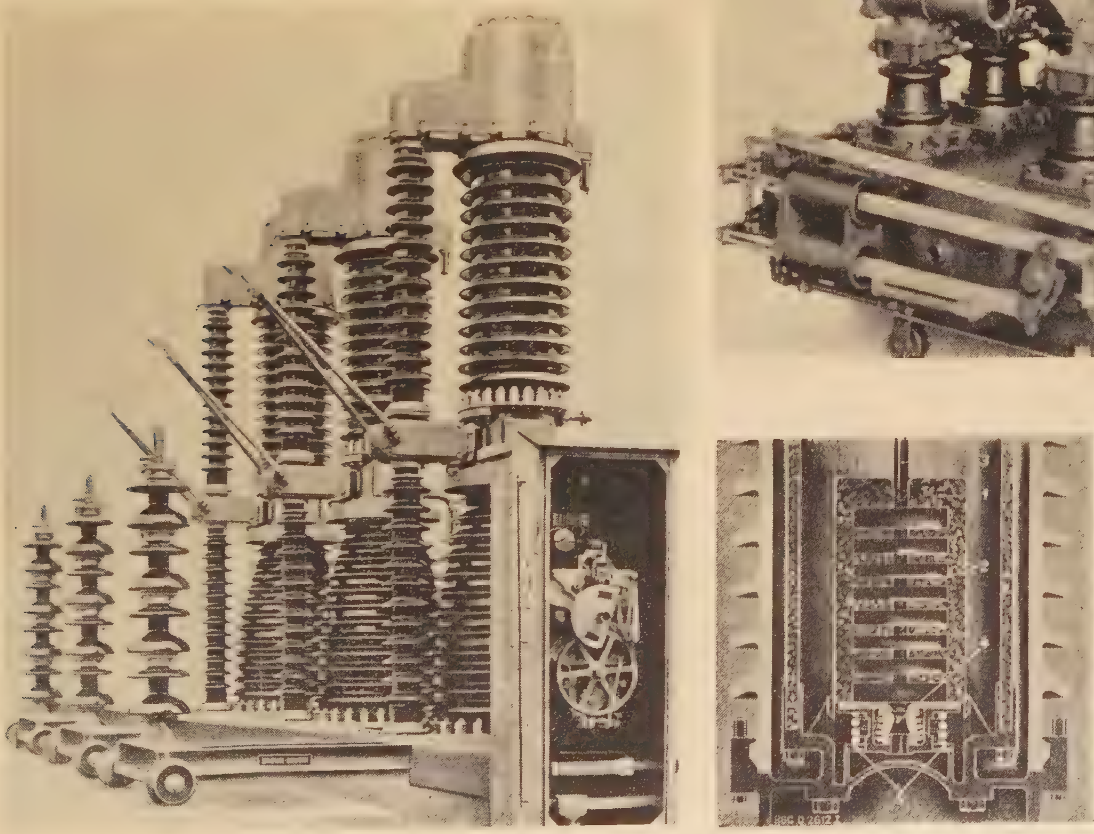


Figure 20. Three-pole low-oil-content high-voltage circuit breaker (Brown Boveri)

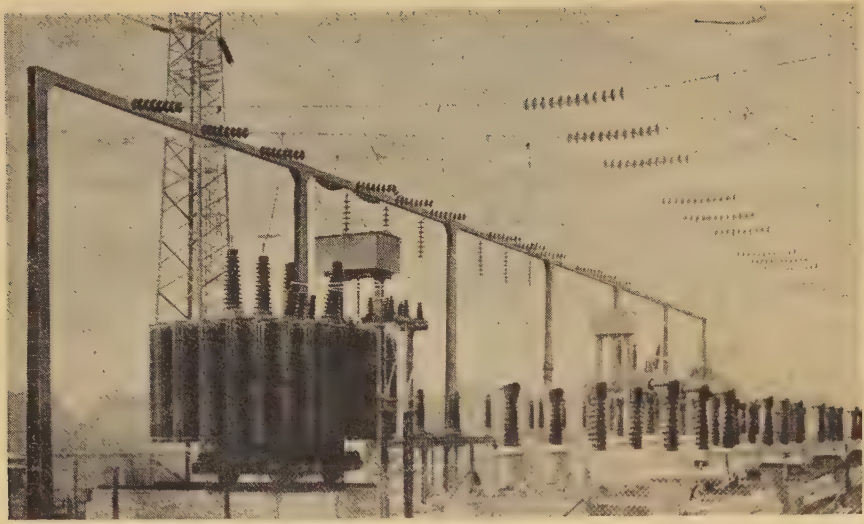


Figure 21. A 110-kv outdoor substation, employing newest design AEG air-blast circuit breakers

Circuit breakers of the low-oil-volume designs give stations a radically different appearance from those with which American engineers are familiar. Figure 21 shows one of the newest installations of high-voltage AEG air-blast breakers in a station. In this instance current transformers are separated from the circuit breakers. This station is an example of a practice very common in Europe. All the circuit breakers and all the disconnecting switches are pneumatically operated from the same central air supply. This practice is not limited to air breakers but is found very generally with the low-oil-volume types of oil breakers as well as conventional tank-type breakers and appears to be growing.

There were some instances in England where air operators were provided interchangeably with solenoids; and were preferred because they permitted considerably higher speeds of closing. For comparison with the station design just shown, figure 22 shows the 287-kv oil impulse breakers installed on the transmission line of the Los Angeles Bureau of Water and Power from Boulder Dam to Los Angeles. It may be noted that in this design the current transformers [end columns] are large compared with the interrupting elements of the circuit breaker. Here, balanced current relaying is employed and it was therefore necessary to maintain current-transformer accuracies at high current values, a material economic handicap as compared with Continental design.

Since economics has been mentioned, it may be interesting to compare a few sizes of circuit breakers made in the United States with the nearest comparable designs made abroad. Figure 23 shows such a comparison for a 75,000-kva 15-kv breaker. Manufacturing costs in the United States, England, and France are substantially comparable although European costs are less. The German breaker is not comparable in duty. The German tank-type breakers are produced only for export and are of a very light-duty type. This is apparent in the comparison of "Weight Less Oil" on the same chart. It may be observed that the costs per pound of the German and the American breakers are of the same order.

A breakdown of this manufacturing cost indicates that the advantage of the European is very largely in the matter of labor rates per hour; whereas the number of man-hours going into the breaker is very much greater. Two factors are involved here. Because of the lower hourly rates, labor-saving equipment and processes need not be applied to the same extent. Also, it is possible that the accounting practices are not quite the same so that the man-hours cannot be interpreted literally. At the same time, it is obvious that in the United States it has been necessary to reduce the number of man-hours materially below that of the European competitor in order to secure a comparable cost.

Figure 24 shows a 1,000,000-kva circuit breaker of the tank type. In this size, in spite of the wage differential, it has been possible to show an over-all lower cost for the American breaker as compared with the French and German, although the English product is still lower in cost.

Figure 25 carries the same comparison through to the large 1,500,000-kva circuit breaker. In each of these instances tank-type breakers are being compared. Such tank-type breakers are practically obsolete except in England. It was desirable to compare the relative cost of the low-oil-volume types. Here direct comparisons

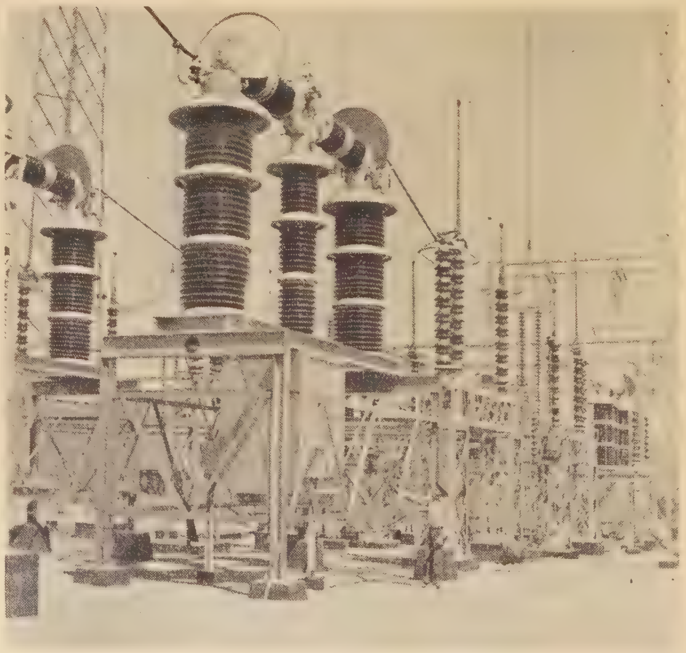


Photo courtesy of D. M. Simmons

Figure 22. A 287-kv switching station, employing low-oil-content impulse breakers, of the Bureau of Water and Power, City of Los Angeles, Calif.

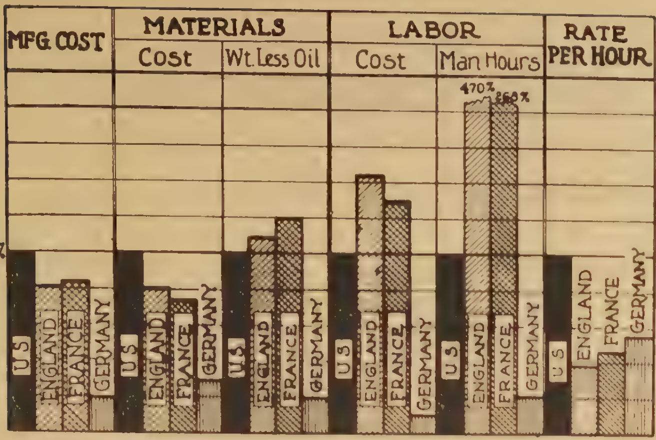


Figure 23. Cost comparison of small circuit breakers
75,000 kva, 15 kv, 600 amperes

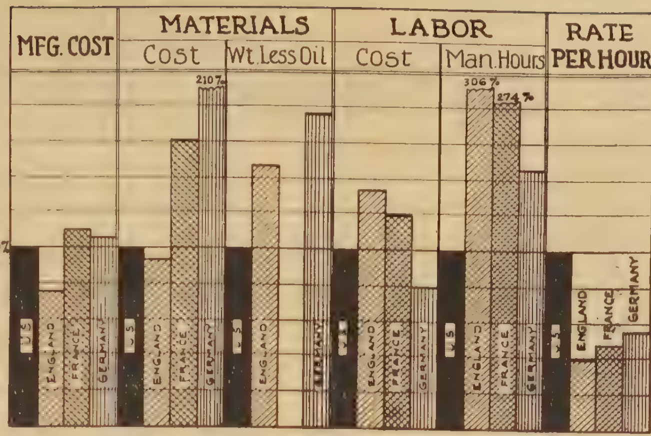


Figure 24. Cost comparison of medium circuit breakers
1,000,000 kva, 15 kv, 1,200 amperes

are difficult because of the extreme differences in the material employed. However, it appears that in general there is a saving in material, in favor of the low-oil-volume type, whereas the man-hours of labor are greater. Thus, such designs would tend to compare unfavorably in the United States where the labor rates are considerably greater. However, it is hoped that ways will be found of equalizing these costs so that the tank and low-oil-volume designs can be compared at some future date on their merits, from a performance standpoint.

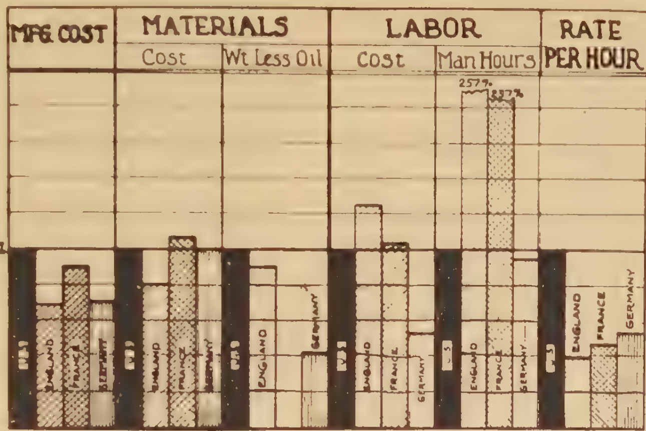


Figure 25. Cost comparison of large circuit breakers
1,500,000 kva, 115 kv, 600 amperes

There is some tendency to regard the lower wage rate paid abroad as a matter of international exchange. We wonder whether, by devaluing the dollar, the United States might be made competitive with these foreign countries. However, it is believed that the difference goes deeper than foreign exchange rates and is really a question of living standards. Figure 26 shows the number of hours which must be put in by a workman to pay for a typical grocery order, consisting of one quart of milk, one loaf of bread, one dozen eggs, and one pound of meat. In every case the European has to work two hours and more for every hour worked by the American laborer to secure the same groceries. These differences are in general greater than the differences in wage rates as shown in circuit-breaker cost comparisons, that is, the foreign worker receives fewer dollars and each dollar buys less.

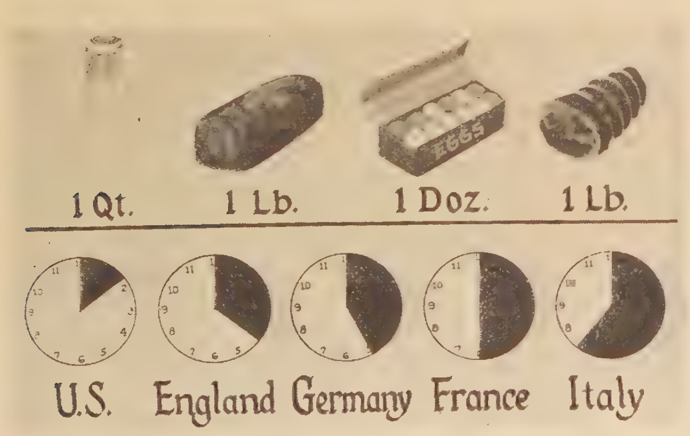


Figure 26. Comparative costs of necessities in hours of labor in the United States and other countries

Wherever the higher purchasing power of the American worker makes it possible to distribute manufactured products in sufficient volume, the costs in the highly mechanized industries are less both in currency and in the equivalent hours of labor than in foreign countries. In apparatus produced in limited amounts, even the highly mechanized factories cannot fully compensate for the higher labor rates, so that some protection for the American workman is necessary. His living standards must be protected from outside competition just as his social standards are protected from undesirable alien influence.

The same objection does not apply to foreign designs. Perhaps Italy cannot afford to store tank cars of precious fuel in circuit breakers. Low oil or oilless designs are certainly safer from air raids. Porcelain may be relatively cheaper than iron in Germany. After these and other factors have been weighed, those elements of European design which compare favorably with American for home operating requirements will be incorporated in domestic practice. The problem is to find which these elements are, and how they can be combined into an acceptable domestic design.

Some Observations on

Economics, Politics, and Government

By JAMES D. MOONEY

On the basis of 20 years' observation of governments in various parts of the world, the author presents here some opinions concerning the functioning of those governments and draws some comparisons between the American form of government and those abroad. He urges all American engineers to contribute intelligent support to their established political system.

MY FIRST trip abroad was with the American Expeditionary Forces as one of the two million men who went over to France to make the world safe for democracy. During the past 20 years, I have spent about half my time abroad. It has been my good fortune to occupy a front seat at many political dramas during those 20 years—the turmoil in Germany, the throwing out of royalty in several European countries, many revolutions in Latin America, and the experiment in so-called communism in Russia. Besides, I have always had a financial stake in the outcome of the drama; such an interest has a way of sharpening one's powers of observation, and of deepening one's sight into what is really going on.

Out of this experience, then, may I simply make a report on my observations of governmental structures abroad. Perhaps, too, I may offer a few suggestions as to how we can do our part in keeping our own American governmental house—the house which has sheltered us comfortably and even luxuriously for 150 years—weather-stripped and insulated against the economic tempests and political hurricanes which beset us at the present time.

In this report and recommendation, I should like to leave with you but four ideas:

1. That the terms fascism, communism, socialism, and democracy are of little value in comparing the forms of government throughout the world.

2. That governments differ principally according to the extent to which they control the lives of their citizens.

3. That the trend of many governments today, *and the trend which constitutes a danger for us in America*, is the trend toward too high a degree of integration—too great a control over every area of the lives of men.

4. Finally, that our most practicable defense in America against too much government in our private economic lives is the maintenance and preservation of our traditional two-party political system, the system that has divided us, at least at election time, into Democrats and Republicans.

Little Significance to Political Terms

While Walter Lipmann, Dorothy Thompson, General Johnson, Heywood Broun, and other columnists have been battling passionately about how many economic angels could stand on the point of some political needle, called communism, fascism, socialism, or democracy, I have been forced into the conclusion by experience that there is very little significance to these terms at all.

My first great disillusionment about these political terms came during my experience when I was contributing my infinitely small bit toward making the world "safe for democracy." In that war I discovered along with many others that symbols didn't make much difference—that underneath their various uniforms men had pretty much the same hopes and fears, joys and sorrows, loves and hates, whether they fought for emperor or czar, king or potentate, dictator or democrat.

My second great disillusionment about these political terms came during a trip through Russia in 1931. I had the opportunity at that time to observe throughout Russia many vast industrial projects under construction—the great hydroelectric power plant at Dnieperstroy, the coal mines of the Donetz Basin, the huge tractor and agricultural implement plants at Karkhov, and the vast state farms in the Caucasus. I had understood meantime that I was going to observe an experiment in Communism.

But all of the economic life in Russia, as I saw it, had the same general pattern I had observed throughout the rest of the world, including my own country. When I confronted various Russian officials with this observation, they explained to me that they hadn't yet had time to get around to Communism, they were too busy with their five-year plan!

Universal Pattern of Economic Life

It has been my general observation that not only in different countries but from generation to generation men go on earning their living in very much the same manner. Notable changes and improvements can be credited from time to time to the scientists and engineers, and in general to improved technology, but economic laws and the processes of production and distribution seem to display a

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Essentially full text of an address delivered at the "All Engineers Dinner" held during the Eighteenth Annual Assembly of American Engineering Council, Washington, D. C., January 14, 1938.

JAMES D. MOONEY since 1923 has been vice-president in charge of overseas operations of General Motors Corporation, New York, N. Y., and president of General Motors Export Company. He has received the degree of bachelor of science from New York University, and the degrees of mechanical engineer and doctor of engineering from Case School of Applied Science. He began his career as mining engineer in 1909, later becoming associate editor of the Hill Publishing Company, New York, N. Y. (1911), and sales manager of the Hyatt Roller Bearing Company (1915). During the World War, he served as captain of the 309th Ammunition Regiment, 84th Division, United States Army, in France. In 1920–21 he was president and general manager of the Remy Electric Company. Mr. Mooney first became affiliated with General Motors in 1921, when he was appointed general manager of the General Motors Export Company. He is a member of The American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, and the Society of Automotive Engineers.

lovely contempt throughout history for changes in the political complexion of government.

Farming, spinning cotton, weaving cloth, making shoes, building ships, manufacturing motor cars, operating railroads, department stores, fruit, vegetable, meat, and fish markets, and trading posts, display no more variation in their character in different countries than can be discovered within the boundaries of any one country. In other words, they show no variations whatsoever that can be ascribed to political boundaries. These processes of production and distribution vary only according to the degree to which methods have been improved through the use of tools and technology.

Economic Betterment Used as a Political Slogan

Meanwhile, and particularly since the middle of the nineteenth century when the industrial revolution got into high gear and brought economic issues sharply to the fore in the western world, politicians have pre-empted or achieved authority under one economic plea or another to the masses. America has no monopoly on the "full dinner pail" we inherited from Mark Hanna, the "chicken in every pot" Herbert Hoover insisted we take even if we liked sirloin steak better, or the New Deal that promised us a whole table d'hote dinner but threatens from time to time to leave us grateful if we actually get the hot soup.

These political symbols have been used continually for generations throughout the world, and they are being used universally right now. Symbols for better food, clothing, and shelter are always useful in inspiring either bloody or bloodless revolutions. History shows that empty bellies are the most powerful generators of political change.

I have observed generally in my travels that the pictures the politicians paint that are bulging with full dinner pails for the workmen, and with pots of gold for the business men, have strange or even weird economic colors. In fact, the programs that are projected for taking us all into the land of milk and honey are often quite openly in defiance of some very old and universal economic laws.

Cardinal Principles of Organization

In appraising the many experiments in government throughout the world that have been tried during our generation, it is important that we should not be thrown off the track by the incident that the various revolutionary movements or changes in government have adopted different symbols around which to rally their supporters.

The important point is to recognize the plain fact that once the controlling group gets into power, the practical circumstances of the situation force the new leaders to organize the government according to organization principles that are as old as the hills.

All through the ages, human groups have been organizing themselves to move on various objectives. And in all these organizations, we find three cardinal principles governing their form and operation:

1. Co-ordination, with its implied corollaries, authority and leadership.

2. The scalar process, that is, the delegation of authorities and duties.

3. Functionism, or the division of duties according to the character of the work to be done.

Wherever we find sound group association or group movement progressing effectively toward an objective, we find the formal structure and the process of moving in full harmony with these principles, whether the organization happens to be concerned with government, with industrial problems, with military objectives, or with any other activity in which a group of men work together to get a job done. Further, it is very plain that all effective or efficient governments have functioned according to these principles, wherever the leaders have had the wisdom and the strength to apply them. Still further, we must recognize that the general objectives of government are the same in every country.

Objectives of Government and the Ideal Economic State

The primary objectives of government are first, military, and second, economic in character. National defense, because of disturbed political conditions throughout the world, is today the first consideration; an improved economic order is the second. After national security, people everywhere want more to eat and a greater variety of things to eat. They want more clothes and more shoes. They want more comfortable places in which to live. All governments are seriously concerned with policies which will provide group movement toward these ends.

In the ideal economic state, steps would be taken to see that no economic group, in pressing for its own advantage, did anything inimical to the general economic progress of any group or of the nation as a whole. Every economic group would be challenged to play the game fairly with the others.

In this ideal economic state, the consumer's interests would be placed above all else. A consciousness would be maintained of the fact that only a vigorous production or transformation of raw materials into consumer goods and the efficient distribution of these goods can create a high standard of living. It would be realized that what is inimical to the interests of the consumer is ultimately inimical to the interests of industry. Profiteering, charging more for the goods or services than they are worth, would be discouraged. Racketeering, the levying of tolls on industry for no service at all, would be banned.

In the ideal economic state, the government would stick to its natural functions of maintaining order and security at home, and providing a defense against external enemies. By limiting the extension of its functions, and by performing its own normal functions with thrift, it would avoid laying on productive industries the heavy hand of taxation that has been the cause of the traditional clash between government and industry in all history. Unfortunately, we observe today, in all of the great industrial countries, taxes that are starving or crushing or drying up industry; the thread of this color is weaving itself with tragic irony into all the relations of industry and government.

The Great Difference—The Degree of Integration

Now I have no intention of saying that all governments throughout the world are alike; not at all. But I do want to say that the general structural pattern, the organization principles under which they operate, and the general objectives they seek to attain are universally similar, regardless of what the form is called. And, most importantly, the principal difference I have observed during my 20 years of watching and feeling the various governments in many countries actually functioning—the principal difference between these governments—lies in the degree to which they are integrated. By "the degree to which they are integrated" I mean the extent to which control is centered in the government over the many areas of individual, community, and national life.

It has become quite the fashion for every newly established régime or government to promulgate the thesis that it is projecting new principles into its operations, among which the principle of high integration is usually prominently displayed. Actually, a characteristic which appears in almost all ancient forms of governments is the unlimited range of governmental authority and control. How ironic, therefore, that many modern countries which are generally regarded as conducting experiments in government should actually be operating according to the methods of the governments of antiquity!

Probably those who have traveled or worked professionally abroad have observed that the degree of integration depends upon the amount of external military or internal economic pressure that is being imposed upon the nation at the time. Military or economic crises set the stage for moving a country in the direction of extremely high integration.

Students of history have probably observed that throughout the classical revolutions the most important net result was that the degree of integration was changed. The general process that seems to take place in any one country really represents, from time to time, only a change in the degree of integration of the government, in response to real or simulated emergencies.

Most of the principal countries throughout the world have been moving, during the past 20 years, in the direction of high integration. Governments everywhere seem to be taking an increasing interest in and control over the economic life of their respective citizens. Picking examples out of the bag, I might mention Germany, Russia, Italy, England, and the United States as examples of countries that have had strong enough governments during the past several years to impose in varying degrees remarkable and increasing governmental control over industry, agriculture, and the general economic life of their citizens.

The American Two-Party System

Now, all of us want strength in our government, but at the same time we are eager to retain the greatest possible degree of individual freedom. I am convinced, meantime, that the defense we need in the United States against too much governmental control is to be found in the traditional American two-party system. Our political scheme—our two parties, the Democrats and the Republicans—have given us, at least during the past 50 years, a reasonably good compromise between a strong government and individual freedom.

I should hate to say that they could not have done a lot better. As a matter of fact, I have spent a lot of time and energy during my life, just like any other American, grousing about the government. But I must remind you that men are not angels, and that governments are controlled and operated by men—by politicians. I came to the conclusion a long time ago that it is just as difficult to be a great statesman as it is to be a great financier or a great engineer. My hat is off to the politician who makes a reasonably good average record in the compromise between so-called "sound principles" on the one hand, and, on the other, what people in their inertia will accept at the moment.

To be practical, therefore, we must compare our political and governmental scheme not with some imagined ideal, but with the actual governmental schemes in other countries. Governments abroad seem to go to one extreme or the other: Either the government is so highly integrated, so strong, so "full of itself" that the individual loses too great a measure of his individual freedom, or the government is so weak that it cannot discharge effectively its ordinary functions.

For 150 years our American two-party system has given us a good practicable compromise in government. We have had strong government, but we have escaped extreme tyranny.

"Too Democratic"—A Sign of Weakness

I have emphasized the two-party system rather than identify our American scheme simply as democratic, because there is such a thing possible as a country being too democratic. We shall be very unhappy here if we move into a political situation in which we have several political parties pushing us all around and striving for control. The trouble with having too many parties in the scheme of things is that no one party has enough power to organize a sufficiently strong government when it is elected to office.

We have observed an excellent example of this in France during the past 12 years. You are all familiar with political conditions there, and you know that they have gone from one crisis to another, arising out of their rather disintegrated political situation. France has undergone the formation of several parties, the continual throwing out of one crowd after another, and, generally, a rather chaotic condition.

Likewise, one of the outstanding characteristics of Germany during its weak and transient régime as a republic, was the multiplicity of parties, which kept breaking up and multiplying until the final debacle. An "overdose" of democracy made the patient very ill, and Doctor Hitler was called in. When this sort of thing happens in a democracy, it provides gratifying material for the "integration-

ists" because they like to point to such a collapse as an example of the breakdown of democracy.

The Middle Road—Our Two-Party System

A system like our own, with its two major parties, avoids this disintegrating tendency and gives ample assurance that either party, if elected to office, will be able to carry out effectively the functions of government. On the other hand, the danger inherent in one dominating party unchecked by sound opposition is obvious. The controlling party can swing to wide extremes of national policy without any check or counterbalancing force to bring the pendulum back to center. With the two-party system, however, the party of opposition is always able to act as a check, a strong and effective balance, against any form of extremism in government.

The two-party system, therefore, is in itself our soundest defense against the excessive governmental control inherent in a single, overdominant party. In the other direction it is again our soundest defense against the weakness and disintegration that arise out of having too many political parties.

By now, however, you are probably saying to yourself: "Well, what has all this got to do with me? What can I do about it?" In coming now to my conclusion, I should like to make a suggestion for the answer to this question; the suggestion is this:

I think you and I ought to be either good Democrats or good Republicans.

If we have ideas and opinions on political economy, if we have ideas on how to organize and run the country, if we have ideals for an American government that would be strong and just and fair, we ought to work within the framework of the party that seems, according to our individual lights, to be moving most surely in the direction of those ideals.

How Much Integration, How Much Government Control?

It seems quite obvious that from time to time we shall have external military and perhaps even further internal economic crises which will provide the emotional background for certain kinds of controls that will be imposed upon us by a strong government. I am not saying that I like the prospect of this, I am simply trying to be realistic about the situation and to anticipate what will actually happen.

I believe that the choice which we shall have to make in our political scheme in the impending years is a choice between a highly integrated scheme of government, or a more moderately integrated one. In times of war or in other times of really intense national crises, I think we can all agree that we are willing to submit to a high degree of integration. But, during peace and ordinary times, we want only a moderate degree of integration in our governmental organization.

Accordingly, my suggestion to engineers, who may be worried at the present time about these political and economic problems, is that they identify themselves actively with one party or the other, as dictated by their own interests and convictions. As intelligent, thinking citizens, lend your full support to that party, and in turn expect from that party some reasonable consideration of your point of view for governmental policy.

Certainly, the most practicable thing we can do is to become active in one party or the other. If you don't like the policies of a party in power, then I say, either join that party and help change its policies and leaders, or join the party of opposition and check the politicians in power or throw the rascals out!

Our Individual Liberty

Only in this way can Americans erect a sure and safe defense against too high an integration of our government, against the overreaching governmental control which would deaden our initiative and creative enterprise, crush us with taxes, and rob us of our very liberties themselves.

Finally, we Americans are not ready yet to concede that we must endure in our government a permanently high degree of economic control. We deserve a scheme of government in this country that will maintain for us our traditional individual liberty. We do not want the government or anybody else continually "snapping us into it."

Even if a highly integrated American government could *guarantee* us a higher standing of living, the vast majority of Americans would prefer to risk a somewhat lower standard of living and have a great deal more liberty to live their own private economic lives. There are still millions of Americans, and I am sure engineers belong to this group, who would like to have the privilege at odd moments and when in the mood, of lying lazily under a shade tree and gazing dreamily at the sky.

Electrification of French Railways

ON November 18, 1937, A. Bachellery read a paper before the Institution of Electrical Engineers (London) entitled "Electrification of the Paris-Orleans and Midi Railways." This paper traces the development of electrification on these properties in considerable detail and is regarded as a worthy contribution to the literature available on electrification. This project now involves the following:

Track electrified	5,524 kilometers
Trolley voltage	1,500 volts, d-c
Annual power consumption	470 million kilowatt-hours
Number of substations	111
Installed substation capacity	357,000 kw
Electric locomotives	638
Electric motor cars	152

The paper further points out that electrification has been a profitable investment and that the electrified lines will be extended.

Determination of the Cause of Sheath Corrosion

By W. G. RADLEY

Failure of the lead sheath on underground cable may be caused by stray currents flowing through sections of the sheath or by local electro-chemical action, either of which destroys the lead by corrosion. In order that proper remedies may be applied, the cause first must be determined; some methods are described in this article.

ELECTRICAL development in any country brings with it problems arising from the coexistence of of power and communication networks in close proximity to one another. In Europe these problems led to the formation in 1927 of an international mixed commission as an adjunct to the already existing international advisory committee on long-distance telephony. The primary object of this commission was the joint experimental study by power and communication engineers of problems arising by reason of electric or magnetic induction. Later the scope of the commission was enlarged to cover experiments relating to the protection of buried pipe and cable systems against chemical corrosion and electrolytic damage, and its membership extended to include technical experts representing the gas and water services.

There are, in addition, several national and local committees comprising representatives of all interests, whose function it is to co-ordinate remedial measures against underground corrosion. Before such measures can be planned, it is essential that the cause and mode of failures should be accurately known. There is, therefore, little wonder at the attention that has been given, to measurements designed to study the path of the damaging stray currents.

What follows is confined to one aspect only of the problem, that of the failure of lead-sheathed cables enclosed in buried conduits. It is an aspect that possesses peculiar difficulties of its own when electrical measurements are involved.

Causes of Corrosion

The lead-sheathed cables that are discussed here are drawn into conduits, usually earthenware ducts, and normally have no other protection. This method of construction is usual for telephone cables in Great Britain. The ducts are made as water-tight as possible, but in practice mud and water may find their way inside and constitute a path by which stray currents can pass between the cable sheath and earth. Whenever a direct current follows such a path, metal is removed at points where the current leaves the sheath. In terms of the electrolysis cell, the areas where this takes place are anodic, the corresponding cathodic areas being at points where the leakage current comes on to the pipe or cable system.

However, the water in the conduit may be of a corrosive nature and itself cause direct chemical attack of the lead. In reality, even such corrosion is of an electrochemical nature, but for convenience such cases where the anodic and cathodic areas are very close together and the electromotive force is self-generated will be referred to as direct chemical attack.

Chemical Investigation in the Laboratory

A most important indication as to the cause of the damage comes from the examination of the corroded sheathing and samples of water and other material sent from the field to the laboratory.

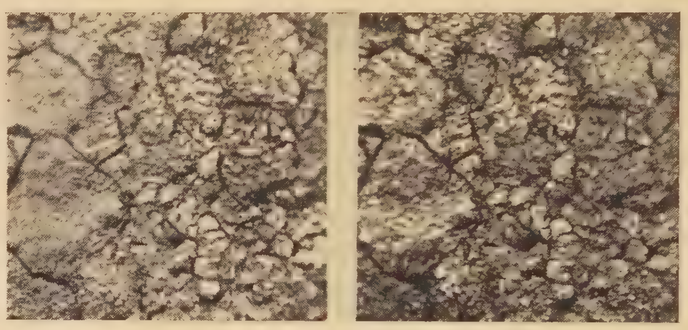


Figure 1. Electrolytic corrosion in natural earth water at 0.25 volt (× 23)

After extraneous dirt has been cleaned as far as possible from the sheath, visual examination gives the first indication of the probable cause of damage. Where failure has been brought about by electrolytic action of stray currents, the corrosion usually takes the form of steep-sided pits distributed at random or sometimes in straight lines over the surface of the metal. Without electrolytic stimulation the corrosion tends to be uniform over the surface of the metal and if it causes pits they are shallow and saucerlike.

The corrosion product, to which reference will be made later, having been carefully removed, the pits may next be examined under a low-power microscope in the laboratory. Where there has been electrolytic action, attack on the face of the crystal grains is preceded by corrosion along the grain boundaries. Often it has been found that the

Essentially full text of an address presented before the AIEE Washington Section, November 16, 1937; a similar address was presented at the Fourth Soil Corrosion Conference of the National Bureau of Standards, Washington, D. C., November 15–17, 1937.

W. G. Radley, Ph.D. (Eng.), is assistant staff engineer at the Post Office Research Station, London, England, and is responsible for research in chemistry, physics, and protection as well as in certain aspects of telephone engineering. He is member of the sections of the European International Advisory Committee in long distance telephony dealing with telephone interference and the protection of buried cables against corrosion. A graduate of the University of London, he is a member of the Institution of Electrical Engineers.

kind of intercrystalline attack shown by figure 1 had proceeded to such an extent that it was possible to remove individual crystal grains from the sheath with a needle. On the contrary, direct chemical corrosion without external electrolytic stimulation produces a more uniform type of attack in which the crystal boundaries are not subject to preferential damage, as is shown in figure 2.

Other causes such as vibration give rise to intercrystalline disintegration of lead, but when associated with certain corrosion products, such disintegration almost invariably points to electrolytic action.

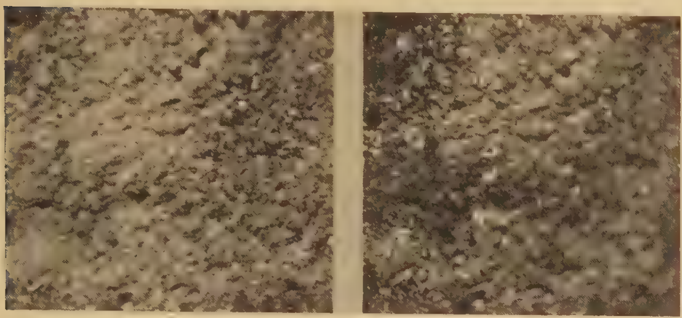


Figure 2. Chemical corrosion in same water as figure 1 (× 23)

The corrosion products are found in the pits where these are present and fortunately—because these products constitute valuable evidence—they remain intact when the cable is withdrawn from the conduit. After removal from the cable sheath, the corrosion products are analyzed in as detailed a manner as the bulk of the sample permits. To a certain extent their composition varies with that of the water in the conduit. All the evidence, however, shows that lead chloride is the first product of electrolysis in normal English soil waters, but that, in contact with such waters, corrosion products rich to this extent in chlorine are not stable. Notwithstanding this, it can generally be said that compounds containing over about five per cent of chlorine are indicative of recently occurring electrolysis. It is of interest that much carefully checked work in research laboratories of the British Post Office has shown that a corrosion product having a composition corresponding to the mineral phosgenite (that is, the chlorocarbonate) is frequently found after electrolysis has taken place at low current densities. Crystals removed from corroded cable sheathing, but having every appearance of the mineral, have been observed under the microscope and X-ray diffraction patterns have shown that the crystal structure of the corrosion product was the same as that of the mineral. Figure 3 shows typical diffraction patterns of lead salts.

The formation of lead peroxide at fairly high current densities is generally accepted as evidence of electrolysis, and is to a great extent independent of the composition of the surrounding water. The test is easy and distinctive, a little of the material scraped from the sheath being placed in a white dish and moistened with a few drops of Trillat's reagent. If peroxide is present a deep blue coloration appears.

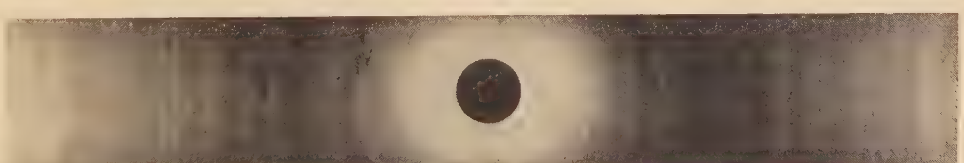
Waters containing normal proportions of chlorides, sulfates, etc., are not usually harmful. The presence of nitrates and nitrites, and of organic matter, particularly in a colloidal form, suggests to the chemist the likelihood of direct chemical attack. Waters containing sewage are particularly dangerous.

Field Surveys

From the examination of the cable and soil water which has just been described, the chemist often will be able to advance a fairly definite opinion as to whether or not damage has resulted from the action of stray currents. The investigation may end here, but some cases of failure reported as due to electrolysis may lead to a detailed electrical survey of the buried cable network with a view to establishing the path and source of the leakage currents and eventually to instituting remedial measures.

As previously indicated, electrolytic corrosion is caused entirely by current passing from the metal sheath to earth by an ionic path, the metal being removed in accordance with Faraday's laws. The essential measurement, therefore, is that of the intensity of the current discharge. When cables and pipes are buried directly in the ground the problem is comparatively simple, and the McCollum earth-current meter developed in the National Bureau of Standards has a wide field of useful application.

Schlumberger's differential method has recently been developed by Gibrat in France and is attracting considerable attention. Three electrodes are placed on the surface of the ground at points equally spaced in a straight line. The central electrode is connected through a galvanome-



LEAD CARBONATE [$PbCO_3$] CERUSSITE

LEAD CHLOROCARBONATE [$Pb(Cl,CO_3)$] PHOSGENITE

Figure 3. X-ray diffraction patterns produced by lead salts similar to those resulting from corrosion

ter to the junction point of two resistances which form a bridge between the two outer electrodes. An adjustment enables the resistance between this junction point and earth to be made equal by way of either outer electrode. When this has been done it is clear that the junction point between the two resistances is at a potential midway between that of the soil under the two outer electrodes. If the current flow in the ground under the three electrodes is uniform and the soil homogeneous there will then be no potential difference across the galvanometer,

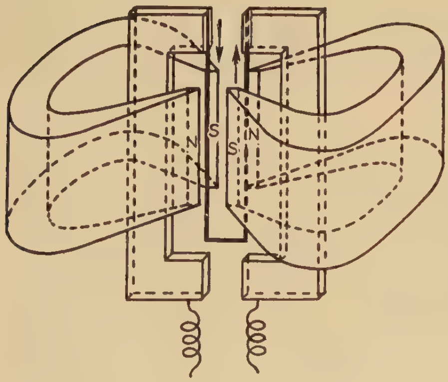


Figure 4. Loop galvanometer, showing the arrangement of the magnets and the loop in its stable hanging position

but, when the electrodes are so placed that a source of current discharge is underneath them a voltage will be indicated. Mathematical expressions exist, by means of which the radial current flow from a buried pipe at a known depth may be calculated when the resistivity of the ground is known. In practice the greatest difficulties are likely to be experienced when making contact between the electrodes and the ground.

The methods just described fail when cables are enclosed in conduits, and it has been the practice of the British Post Office in such cases to rely on simultaneous measurements of the sheath current at two points a short distance apart. At each point of measurement a pair of wires is connected to the cable sheath and carefully adjusted so that both pairs include lengths of sheath of the same resistance. Resistances in series with the testing connections enable the instruments, which are connected across the cable at the two points of measurement, to be adjusted to the same millivolt sensitivity.

Owing to the rapidly fluctuating nature of the stray currents from street railway and other traction systems, it is essential to use some form of photographic recorder for the simultaneous registration of the current at the two points. Further, as the current which it is desired to measure is comparatively small and the resistance of the cable sheath extremely low, the measuring instrument must be capable of giving a reasonable deflection when 0.01 millivolt is applied to its terminals. Also, as it has to be used in the street, it should be readily set up and not affected by a certain amount of vibration. It has been found that a galvanometer consisting of a loop of extremely thin aluminum foil suspended between the poles of two permanent magnets fulfills these requirements. The loop has a resistance of between five and seven ohms. As it is extremely light, its deflections are aperiodic; and, being sealed in a glass cell, it is not disturbed by drafts or air currents. The two permanent magnets are arranged as shown by figure 4 so that, when current is passed round the loop, both limbs are deflected to the same side. The loop is supported by its own stiffness against movement in a plane at right angles to this. For the purpose of obtaining a continuous record, an image of a small part of the loop may be projected by means of a filament lamp on to a photographic film.

Figure 5 shows the complete equipment developed by the British Post Office for use in detailed field investigations. A double record is taken on a film driven forward at a speed of from one to three inches per minute by a small six-volt motor. This and the projection lamps for the galvanometer are supplied from portable batteries, the whole equipment being easily transported. Typical records are shown in figure 6. The two records give by difference the net current flow to earth between the points of measurement and indicate the extent to which the cable length is endangered. The method is open to the criticism that it measures the average current loss over a fairly long length and gives no indication of "hot spots." Although this is true, it is the only method that will measure even the average loss. It also has the great advantage that records obtained in this way to give very clear indications as to the origin of the sheath current. Stray return current from heavily loaded street railways fluctuates very rapidly. With less heavily loaded lines the changes resulting from the movement of individual cars become apparent as shown

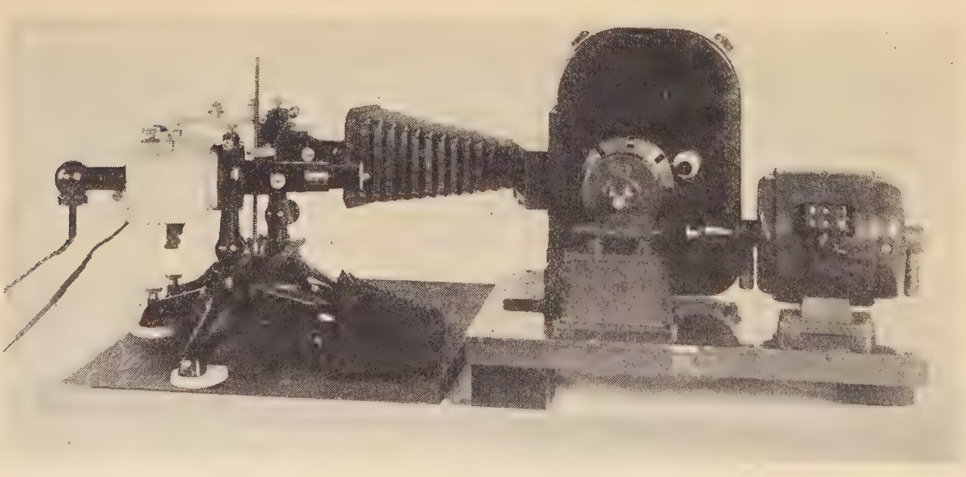


Figure 5. Field equipment consisting of two loop galvanometers and photographic recorder as used by the British Post Office for special investigations

by figure 7. These changes are quite different from the slow variations which alone occur with currents electrochemically self-generated in a long line.

The difficulties in the way of direct measurement of the current discharged from a cable enclosed in a conduit forces one back to measurement of the potential difference causing this current to flow. Unfortunately electrolysis takes place with potential differences no greater than the error involved in measuring them to any simple lead-earth electrode. For this reason some use has been made of nonpolarizable electrodes and calomel half cells, which are not subject to such errors. Figure 8 shows a nonpolarizable electrode suitable for pulling along a conduit in order to explore the potential field. Connections can be made to the measuring instrument by means of rubber-insulated leads.

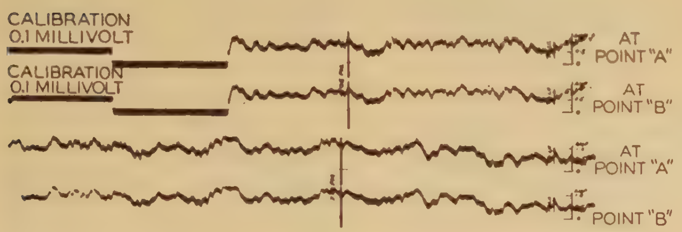


Figure 6. Cable-sheath currents at two points

In the majority of cases the harmful nature of the soil water is apparent, or the layout of an adjacent street railway gives ample reason for presupposing the occurrence of stray currents. The experience of the British Post Office has led to the conclusion, however, that even then it is necessary to take into consideration the results of all possible tests before forming a conclusion. To the experiments which already have been outlined must be added due consideration of the local conditions. In fact, a flair for picking out underlying causes, which is born only of experience, is frequently demanded of those engaged in investigating cable-corrosion problems.

Figure 7. Record obtained by use of loop galvanometer and photographic recorder, showing current in a telephone-cable sheath resulting from movements of a single streetcar

A badly corroded cable removed from an iron conduit is one example of the unusual. Quantities of basic lead carbonate suggested chemical attack; on the contrary, the iron pipe from which the cable was withdrawn was practically dry. The presence of an ice factory and the habitual placing of ice blocks on the pavement above the conduit suggested the real cause, which was the condensation of moisture on the cable. Very pure water, and condensation water in particular, has a serious solvent effect on lead, but is seldom expected in a cable conduit.

Protective Measures

Correct diagnosis is, however, only the preliminary to the proper planning of protective measures. These vary according to the severity of the conditions. In Great Britain the addition of a chemical inhibitor to the grease used for lubricating cables as they are drawn into the conduit has been found to give an increase in life of more than 40 per cent in areas where chemical attack is prevalent. Where the conditions are more severe and result from the presence of stray currents in the ground two modes of protection have been adopted in Europe; cables are either insulated from their surroundings to the maximum extent practicable, or steps are taken to conduct the stray current from the cable sheaths in such a way that no damage is caused.

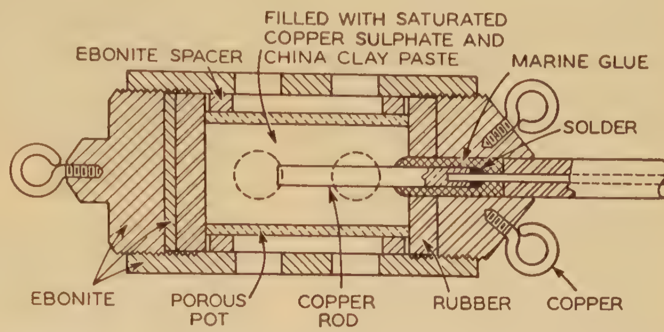


Figure 8. Copper-sulphate nonpolarizable electrode used in cable ducts

The first mode makes use of insulating wrappings and special methods of laying, amounting in some instances to the cable being contained in a wooden trough filled solid with a bituminous compound. Such methods naturally result in a cable layout which cannot readily be changed to meet development.

The second mode of protection is applicable to a normal layout consisting of bare lead-sheathed cables drawn into conduit.

As an example of the application of this system, the telephone cable network in Milan has been divided into 16 isolated sections by 343 insulating joints. Each of these sections is connected to the rails of the street-car system at one point by a drainage bond and 354 shunted insulating joints regulate the potential of the cables within the sections.

The conception of such a protective scheme depended on a great number of electrical measurements in the field. That schemes of such magnitude are being applied and that extensive study is being made in many countries of the causes giving rise to cable corrosion are evidences of the problem that has developed underground.

Converting 2.3-Kv Feeders to 4-Kv Operation

Outlining a Successful Method of Procedure

By E. R. COOP
MEMBER AIEE

O. E. SAWYER
ASSOCIATE AIEE

Although the question of the relative merits of converting 2,300-volt distribution feeders to 4,000-volt operation has been treated liberally in technical literature, relatively little has been published concerning efficient methods of accomplishing such conversions once they have been decided upon for economic or other reasons. Hence the accompanying outline of a successful procedure is presented in the hope that it may be of interest and value to many engineers faced with some of the problems involved. The authors are in effect presenting the accumulative results of three years of actual field work incident to the conversion of some 45 distribution feeders.

THE QUESTION of 2,300-volt versus 4,000-volt operation of distribution feeder circuits has been discussed liberally in technical literature that is readily available. Hence it is the purpose of this article to describe the principal features of a method of making such a conversion that has proved to be effectual in systematizing both the planning and conduct of the work involved, presupposing that a decision to do the work already has been made.

An increase in distribution voltage, of course, reduces the voltage drop and line loss for a given load, thereby increasing the feeder capacity. The change from a 2,300-volt ungrounded-delta to a 4,000-volt grounded-wye system accomplishes the desirable voltage increase with a minimum of increased investment, since most of the apparatus used on both systems has the same voltage rating.

Principal features of a change from a 2,300-volt delta to a 4,000-volt wye system are the installation of a fourth or neutral conductor, and the reconnection of single-phase transformers and three-phase transformer banks. Incidentally, the undertaking of such work offers opportunity for the economical accomplishment of general rehabilitation including tree trimming, the installation of tie and sectionalizing switches, and other necessary or desirable system improvements. The great number of details involved in the installation of the neutral conductor and the reconnection of apparatus must be co-ordinated accurately by a definite system of planning. Co-ordination is especially difficult in this type of work since the project is spread over a large area. In the following discussion, the work is described as nearly as possible in the order in which it was found to be performed to best advantage.

Field Survey

Initially, a thorough field survey is made, recording the following data on a suitable record form.

1. Connections at all junction poles.
2. Size and condition of conductors.
3. Availability and location of pin space for neutral conductor.
4. Number of fuse cut-outs and lightning arresters to be removed and the number to be replaced.
5. Size and location of poles to be replaced, due to deterioration, or in order to provide adequate clearance in the pole top construction.
6. Number and condition of connections between the underground and overhead parts of the feeder.
7. Approximate amount of tree trimming required.
8. Size, location, and high-voltage connections of single-phase transformers and three-phase banks.

Where visual tracing is not possible, in underground construction, for example, a fault locator is used to reveal the connections of conductors. To discover which two of the three high-voltage wires supply a single-phase transformer, the fault-locator signal is impressed on the low-voltage winding (at a customer's service), and the detector is used at the substation or other convenient location. Definite identification of these two wires is made by means of a phase-sequence indicator connected to both conductors and ground. This is done conveniently when the transformer fuse cut-outs are opened to allow transferring of one high-voltage lead to the future neutral.

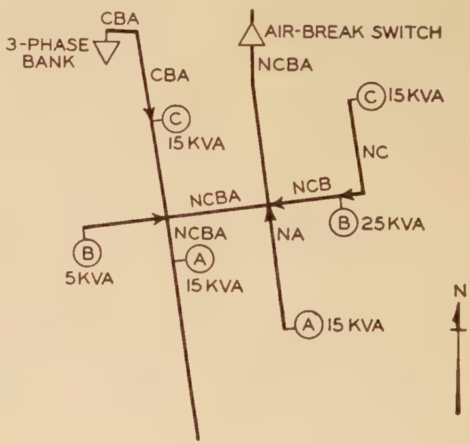


Figure 1. Section of typical final balance plan

Letters indicate phasing at 4,000 volts
Arrows indicate changes in number of wires

These data ordinarily are sufficient for estimating the cost of the project, and also they serve as the bases for planning the work.

Essential substance of an address presented December 14, 1937, before the Institute's Providence (R. I.) Section. Written especially for ELECTRICAL ENGINEERING.

E. R. COOP and O. E. SAWYER are with The Narragansett Electric Company, Providence, R. I. Mr. Sawyer is currently the secretary of the AIEE Providence Section.

Planning

The first step is to prepare a plan depicting the desired ultimate circuit and equipment arrangement to be attained. This so-called "final balance plan," a typical section of which is shown in figure 1 is a single-line map of the entire feeder indicating the final phase order of conductors and showing to which phase each single-phase transformer is to be connected. The final balance must satisfy two conditions:

1. The load should be approximately balanced along the feeder as well as at the station. Connected transformer capacity usually is a sufficient guide for determining the balance.

2. To minimize possible inductive interference with communication circuits, the three line or "phase" wires should be of as nearly equal length as possible, counting underground cable as the equivalent of 20 times its length in open wire. A total difference of three miles within the area served by any one substation usually is not objectionable.

Having available a record of the existing condition of the system and a plan of the ultimate desired, the problem becomes one of proceeding from the existing to the final state in such a way that no part can be overlooked, and that the plan of work is presented to the field forces in an easily understandable manner. Four sets of plans have been found to accomplish this result, namely:

1. A plan of the neutral conductor that is to be provided.
2. A plan indicating the necessary "phasing" at junction poles.
3. A plan indicating the necessary "phasing" at points where single-phase transformers are installed.
4. Diagrams for reconnecting three-phase transformer banks.

The *neutral plan* is a single-line map of the feeder on which are indicated the sections where the neutral conductor is to be installed, the size and kind of wire to be used, and the position it will occupy on the crossarm. Configuration of the conductors may make more convenient the installation of the new conductor in a position that will enable it to be used ultimately as one of the line or "phase"

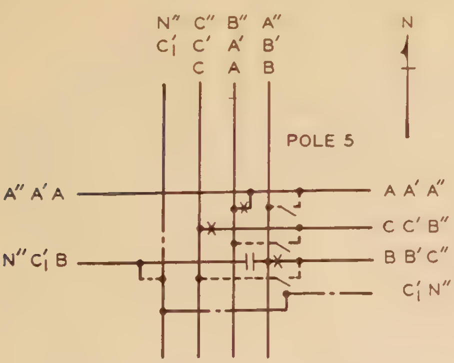


Figure 2. Typical junction pole as shown on the junction pole phasing plan

A B C—Phasing at 2,300 volts before any work is done
A′ B′ C′—Phasing after preparatory work is done
A″B″C″N″—Phasing at 4,000 volts after cut-over is complete
$A_1'B_1'C_1'$—Phase to which neutral wire is tied at 2,300 volts
___/__ Single-pole switch to be closed at cut-over
— - — Connections to be made preparatory to cut-over
—ǂ— Cuts to be made preparatory to cut-over
– – – – Connections to be made at time of cut-over
—x— Cuts to be made at time of cut-over

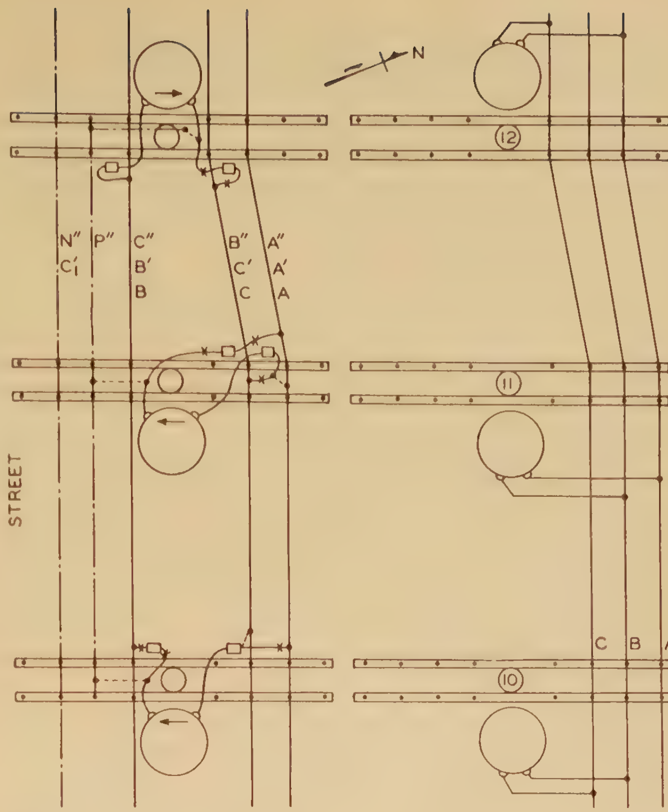


Figure 3. Typical diagram of a three-phase transformer bank, showing existing connections and changes to be made at cut-over in order to secure correct phase sequence and balanced voltage

For legend, see figure 2

wires, in exchange for which the existing line wire ultimately would become the neutral conductor. In such instances, the neutral plan is clearly marked, to prevent installation of the new conductor on the white insulator unit customarily used to distinguish the neutral conductor; these white insulators in such sections being placed on the actual ultimate neutral conductor as part of the cut-over process.

It is desirable to standardize on some geographical arrangement of conductors, such as *A*, *B*, *C*, *N*, reading north to south and east to west. The amount of neutral conductor installed depends upon the location and size of three-phase transformer banks and the final balance desired, although in laying out the neutral plan conditions may be encountered that will warrant a modification of the original "final balance plan." Installation data concerning sectionalizing and tie switches are included in the neutral plan along with instructions for making incidental system improvements. The neutral plan covers the installation of all conductors and devices, but does not include the manner of connection which is shown on the junction-pole phasing plan.

The *junction-pole phasing plan* is a diagram showing all conductors involved in the changeover and the location of three-phase transformer banks. A typical junction pole as shown on this plan appears in figure 2. All changes to be made *preceding* cut-over are indicated. These involve tying the neutral wire to a phase wire by means of tempo-

rary jumpers and arrangement of taps so that the conductors will be in the *A*, *B*, *C*, *N* order after cut-over. Where this work requires objectionable outages to customers, temporary switches are indicated for use at cut-over. The neutral conductor is sectionalized with temporary switches, each section being tied to a different phase wire to accomplish the load balance specified in the transformer phasing plan.

The *transformer phasing plan* is similar to the "final balance plan" except that on it connections to the line or "phase" wire with which the future neutral conductor is temporarily interconnected are avoided inasmuch as these two conductors are at the same potential. The function of this plan is to provide for connecting one high-voltage lead of each single-phase transformer to the future neutral and at the same time to facilitate the preservation of a reasonably good load balance, the allowable unbalance being determined by the ampere rating of substation equipment and voltage conditions on the feeder. The transformer-phasing plan includes only single-phase transformers, each three-phase transformer bank being covered by an individual diagram.

A sketch is prepared for each of the three-phase transformer banks showing existing delta or open-delta connections and changes to be made at cut-over in order to secure correct phase sequence and balanced voltage. The diagram also shows the preparatory work required to minimize the outage at cut-over. Figure 3 is a typical diagram of this nature.

It must not be supposed that each of these plans is an unrelated step in the 4,000-volt conversion process and that one may be finished and considered final before all of the others are complete. Actually these several plans are different views of the same problem, and a change in one affects all, just as a change in the plan of a structure affects the elevations. For example: Suppose that a three-phase load on a branch of the main feeder is smaller than the preliminary field survey indicated, or drops off the system entirely. Very likely, the fourth wire would not be added to this branch, thus leaving only two phases available, therefore, for single-phase transformers. In turn, this change in circumstances would require the following chain of modifications: (1) of the "final balance plan," both as to connected load and as to length of line wires; (2) of the transformer phasing plan, (3) of the neutral plan, because no new conductor would be installed; (4) of the junction-pole phasing plan, to show which conductor is to become the neutral; (5) of the transformer bank diagram because, if the load remains, only two tranformers instead of three will be used in the transformer bank to furnish three-phase service. Again, it may be found that connecting a single-phase tap to *A* or *B* phase would block the climbing space on a junction pole that otherwise is in good condition. This would mean that the pole top would require rebuilding, and, if the pole has only a few years remaining life, probably pole replacement would be in order, whereas connection of the tap to the *C* phase would avoid all this extra construction. In such an instance, the final balance, transformer phasing, and junction-pole phasing plans would be involved. As such details continually are arising, a systematic method of notation obviates much confusion.

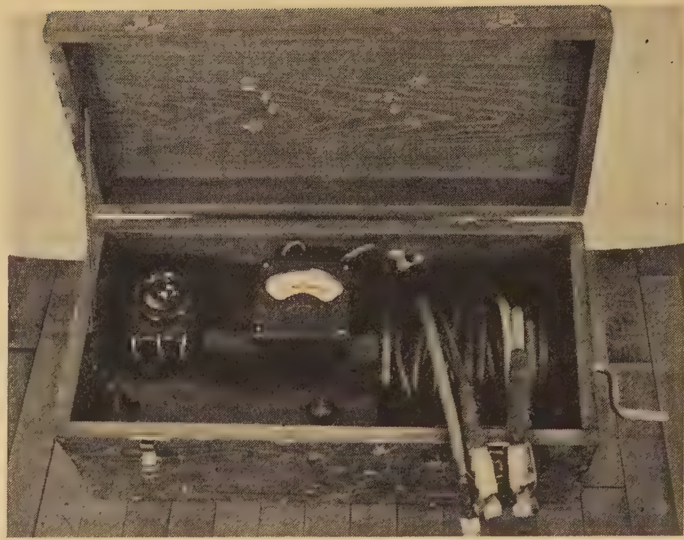


Figure 5. Voltage- and rotation-testing unit

This is a convenient assembly for checking voltage and rotation of three-phase power services of 575 volts and less. Removable handle for cable reel is shown in place. Cables are distinctively colored near the clips so that connections can be checked from the ground when overhead services are being tested. Below the rotation indicator is an insulating handle to operate disconnects which, when open, leave the voltmeter alone on the test leads. Below the voltmeter is a knob connected to a transfer switch which shifts the voltmeter from phase to phase

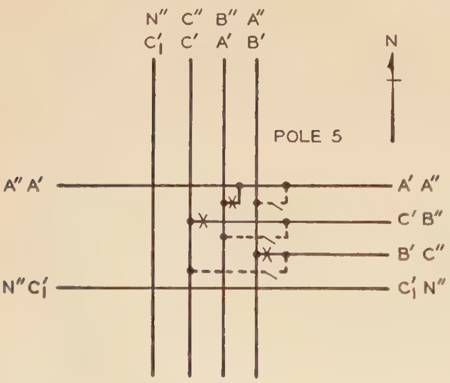


Figure 4. Typical junction pole as shown on cut-over plan

For legend, see figure 2

Cut-Over

A cut-over plan is similar to the junction-pole phasing plan except that only the work necessary *at cut-over* is indicated. The junction pole referred to previously in the junction-pole phasing plan is shown in figure 4 as it would appear on the cut-over plan. This plan, together with a detailed schedule of procedure, and a complete set of three-phase-transformer-bank diagrams, are issued to the engineers who are to participate in the cut-over.

A day or two previous to the date of change-over, a rehearsal is conducted at which the engineers and their line crews become familiar with the work involved. At this time, red tags are installed on switches that are to be closed at cut-over and white tags are used to indicate cuts that are to be made. The voltage and phase sequence of three-phase banks are checked using the outfit shown in figure 5.

Elmwood 4-Kv Cut-over—Feeder 7HJ-4

Part III: Headquarters—Pole 52, Reservoir Avenue

1. Disconnect power load—report to headquarters		
Sawyer	4 Garden and 13, Beckwith Street	8:05
	Pole 12 and $13\frac{1}{2}$, Pontiac Avenue	8:09
Andrews	Pole 53 and 54, Reservoir Avenue	8:06
	Pole 6 and $6\frac{1}{2}$, Rounds Avenue	8:04
Springer	Pole 08, Wellington Avenue	8:05
	Pole 14, Margaret Street	8:07
2. Stand by for Wilson at:		
Sawyer	Pole 4, Pontiac Avenue	
Andrews	Pole 20, Rounds Avenue	
Springer	Pole 45, Reservoir Avenue	
3. Wilson give following instructions and get OK's:		
Sawyer	Pole 4, Pontiac Avenue	
	Open three quick breaks	8:14
Andrews	Pole 20, Rounds Avenue	
	Make one cut and one tie	
Springer	Pole 45, Reservoir Avenue	
	Cut neutral jumper	
	Close neutral switch and three quick breaks energizing at 4 kv	8:16
4. Proceed to reconnect power load		
Sawyer	Pole 4, Garden and 13, Beckwith Street	8:23
	Pole 12 and $13\frac{1}{2}$, Pontiac Avenue	8:29
Andrews	Pole 53 and 54, Reservoir Avenue	8:36
	Pole 6 and $6\frac{1}{2}$, Rounds Avenue	8:21
	Close neutral switch, pole 23, Narragansett Avenue	
Springer	Pole 08, Wellington Avenue	8:23
	Pole 14, Margaret Street	8:29
5. Proceed to new headquarters—pole 19, Niantic Avenue		

Figure 6. Typical cut-over schedule

The cut-over itself usually is scheduled for the early morning hours of an off-peak day, to reduce to a minimum the number of customers affected. Assuming that the preliminary switching, if any, has been completed and checked, the first step is to disconnect the three-phase banks on the first section of the feeder to be changed over. The section is then de-energized, any necessary changes in conductor phase order are made, the neutral is cut clear from its associated phase wire, and the section is energized at 4,000 volts. Reconnection of three-phase transformer banks, and a check of the phase sequence and voltage completes the cut-over of the section. The service interruption seldom exceeds three minutes for single-phase customers or half an hour for customers served by three-phase transformer banks. Figure 6 shows a typical sheet of the cut-over schedule, together with the times at which the various steps were actually performed.

Each engineer in charge of a line crew is responsible for a definite portion of the work, which is co-ordinated by a sponsor engineer, who is in charge of the entire job.

Clean-Up and Final Inspection

Work remaining to complete the conversion of the feeder to 4,000-volt operation consists of the removal of all temporary switches used at cut-over and the balancing of single-phase loads. During the work of balancing the feeder, the neutral lead of each transformer is connected solidly to the neutral conductor and a neutral lightning arrester, consisting of a simple porcelain-enclosed gap, is installed. For the use of the construction crew, a balancing plan is issued which is, briefly, the difference between the transformer phasing plan and the final balance plan.

The final step by the engineering department is a thorough inspection of the entire feeder. At this time all structural details are checked, for example: the removal of temporary switches, the removal of unnecessary lightning arresters and fuse cut-outs, the installation of neutral lightning arresters, and the high-voltage connections of single-phase transformers.

A New Swiss Lake

A NEW LAKE, the Sihlsee, recently was created near Einsiedeln, Switzerland. It forms part of the huge Etzel power project, which the Swiss Federal Railroads have been building in conjunction with the "Nordostschweizerische Kraftwerke," at a cost of 65 million Swiss francs [at par, about $12,545,000].

Back in the year 1797 Goethe, the famous German poet, spoke in one of his Swiss travel memoirs of the possibility of utilizing the waters of the Sihl, which has its origin on the Drusberg in the canton of Schwyz, and which, because of mountainous obstructions, has to describe a left turn shortly after Einsiedeln, instead of being able to proceed directly into the lake of Zurich. Engineering skill now has conquered this obstacle. Near the so-called "Schlagen" a tunnel has been bored through the mountain for high-pressure conduits that bring the heavy volume of water to the power station near Pfäffikon on the lake of Zurich. The new Sihl lake, which incidentally has added greatly to the beauty of the Einsiedeln country, is 892.6 meters [2,930 feet] above sea level; it has a length of eight kilometers [nearly five miles], an average width of 1.4 kilometers [more than three-quarters of a mile], a depth of 20 meters [61 feet], and with an area of 11 square kilometers [four and one-quarter square miles], it assumes 15th rank among Swiss lakes. The Sihl reservoir lake will produce yearly 150 million kilowatt-hours of electric energy—110 million during the winter months.

News
Of Institute and Related Activities

North Eastern District Meeting and Student Branch Convention

A PLEASANT three days are in store for all who will attend the North Eastern District meeting of the AIEE to be held at Lenox, Mass., May 18–20, 1938. Headquarters will be at the Curtis Hotel, and arrangements have been made to house those attending in this hotel and in other hotels in town. Lenox is a beautiful New England village situated about six miles from Pittsfield in the heart of the Berkshire Mountains. Attractive entertainment, interesting trips, and technical sessions have been arranged by the general meeting committee, K. B. McEachron, chairman.

Entertainment

Wednesday evening, May 18, a stag smoker will be held at the Town Hall in Lenox. On Thursday evening a mixed banquet will be held with an interesting speaker. On Friday evening, May 20, arrangements have been made for a student dinner and dance to be held at the Stanley Club in Pittsfield. This is essentially an engineering club whose members are drawn entirely from the employees of the General Electric Company. Every attempt will be made to make the students feel at home, perhaps even to the extent of supplying partners for this dance.

A women's committee, with Mrs. V. E. Goodwin, chairman, is actively engaged arranging entertainment for the women in the form of a card party, drives to several of the nearby colleges, and, if possible, visits to some of the many estates around Lenox.

Technical Sessions

Five technical sessions will be held during the meeting. One of these will be a general session in which there probably will be addresses on science or economics, which subjects are of interest to many members. Other sessions will deal with voltage regulation, industrial applications, and selected topics. Friday morning will be devoted to a student session in which papers will be presented by students from several of the universities and colleges within the District.

Inspection Trips

The Pittsfield works of the General Electric Company, the Crane paper mills, and the woolen industry afford unusual opportunity for interesting and instructive insight into these industries. The schedule for these inspection trips has been arranged as follows:

Thursday afternoon, May 19

1. Pittsfield works manufacturing departments of the General Electric Company (approximately two hours).
2. Plastics division of the General Electric Company (approximately two hours).
3. High-voltage demonstration in the 10,000,000-volt laboratory (three-quarters of an hour).

Trips 1 and 2 are alternates because of time limitations, but those attending either trip will be given the privilege of witnessing the high-voltage demonstration.

Friday afternoon, May 20

A. Arrangements have been made to visit one of the Crane paper mills, where the highest quality linen-bond paper is made by the same company that makes all of the paper for government currency. This trip will include perhaps a half hour in the Crane Museum where an attendant lecturer will explain the history of paper making from beginning to end.

B. As an alternate to trip *A*, there will be an inspection of the manufacture of woolen cloth at either one of two woolen companies in the Pittsfield area.

In addition, trips 1 and 2, listed under Thursday afternoon, will be arranged again on Friday afternoon especially for the students, followed by the high-voltage demonstration. Members who are unable to see all of the General Electric works on Thursday could take the alternate trip 1 or 2 with the students, if desired, in place of trip *A* or *B*.

Rules on Presenting and Discussing Papers

At the technical sessions, papers may be presented in abstract, ten minutes being allowed for each paper unless otherwise arranged or the presiding officer meets with the authors preceding the session to arrange the order of presentation and allotment of time for papers and discussion.

Curtis Hotel, Lenox, Mass., headquarters for the AIEE North Eastern District meeting

Tentative Technical Program

Daylight Saving Time

Advance copies will be made available as papers are approved, with the exception of the one already published in ELECTRICAL ENGINEERING and for which reference is given. If ordered by mail, price 10¢ per copy; if purchased at Institute headquarters or at the meeting, price 5¢ per copy. The announcement of the meeting to be sent to members within the District and nearby territory will carry an order form for those who wish to order advance copies of papers.

Wednesday, May 18

9:00 a.m.—Registration

10:00 a.m.—Voltage Regulation

*SYSTEM PLANNING AND OPERATION FOR VOLTAGE CONTROL, **T. J. Brosnan**, Buffalo, Niagara, and Eastern Power Corporation.

*VOLTAGE-REGULATING-EQUIPMENT CHARACTERISTICS AS A GUIDE TO APPLICATION, **P. E. Benner** and **G. S. Lunge**, General Electric Company.

*VOLTAGE REGULATION AND CONTROL OF RURAL LINES, **G. H. Landis**, Central Hudson Gas and Electric Corporation.

*THE PERIODIC VOLTAGE SURVEY AS A BASIS FOR DISTRIBUTION DESIGN, **R. W. Burrell**, Consolidated Edison Company of New York, Inc., and **W. E. Appleton**, New York and Queens Electric Light and Power Company.

2:00 p.m.—Industrial Applications

PHOTOELECTRIC WEFT-STRAIGHTENER CONTROL, **C. W. LaPierre**, General Electric Company, and **A. P. Mansfield**, consulting engineer.

REGENERATIVE TENSION CONTROL FOR PAPER WINDERS, **H. W. Rogers**, General Electric Company.

*COMPARISON OF METHODS OF STOPPING SQUIRREL-CAGE INDUCTION MOTORS, **W. I. Bendz**, Westinghouse Electric and Manufacturing Company.

*THE APPLICATION OF CAPACITORS FOR POWER-FACTOR CORRECTION IN INDUSTRIAL PLANTS, **C. E. H. von Sothen**, General Electric Company.

Thursday, May 19

9:30 a.m.—General Session

Probably addresses on scientific or economic subjects of interest to many members.

Friday, May 20

9:30 a.m.—Student Session

2:00 p.m.—Selected Topics

CORONA VOLTAGES OF TYPICAL TRANSFORMER INSULATION, **F. J. Vogel**, Westinghouse Electric and Manufacturing Company.

MULTIPLE LIGHTNING STROKES—II, **K. B. McEachron**, General Electric Company.

PROTECTOR-TUBE APPLICATION AND PERFORMANCE ON 132-KV TRANSMISSION LINES—II, **Philip Sporn** and **I. W. Gross**, American Gas and Electric Service Corporation.

NEW TYPES OF D-C TRANSFORMERS, **C. C. Herskind**, General Electric Company.
EE, November 1937, pages 1372–8

A DIRECT-CURRENT TRANSFORMER, **T. C. Lennox** and **E. V. DeBlieux**, General Electric Company.

*TENSOR ANALYSIS OF ARMATURE WINDINGS—I, **P. L. Alger** and **Gabriel Kron**, General Electric Company.

* These papers are scheduled for presentation but they have not been accepted for publication at the time of going to press.

Any member is free to discuss any paper when the meeting is thrown open for general discussion. Usually five minutes is allowed to each discusser for the discussion of a single paper or of several papers on the same general subject. When a member signifies his desire to discuss several papers not dealing with the same general subject, he may be permitted to have a somewhat longer time.

It is preferable that a member who wishes to discuss a paper give his name in advance to the presiding officer of the session at which the paper is to be presented. Each discusser should step to the front of the room and announce, so that all may hear, his name and professional affiliations. Three typewritten copies of discussion prepared in advance should be left with the presiding officer.

Other discussions to be considered for publication should be typewritten and submitted in triplicate to C. S. Rich, secretary of the technical program committee, AIEE headquarters, 33 West 39th Street, New York, N. Y., on or before June 3, 1938. Discussion of addresses and papers, which is not for publication, need not be submitted.

HOTELS AND REGISTRATION

Hotel rates during the meeting range from $5.00 to $7.75 per day, American plan, with rates for students as low as $4.50 per day. The Curtis Hotel, meeting headquarters, will handle all rooms whether or not they are in that hotel, and members should make their room reservations by writing directly to the management. Coupon books covering room, meals, entertainment, and trips will be issued at the time of registration at the meeting. A refund schedule has been arranged for those who may wish to omit part of the program.

Advance registration will assist the committees making arrangements and will avoid congestion on arrival. For this purpose an advance registration card will be sent to members in the District and nearby territory. All registrations should be made with L. G. Hamilton, chairman, hotel and registration committee, care of Central Station Department, General Electric Company, 100 Woodlawn Avenue, Pittsfield, Mass. A registration fee of $2 will be charged all nonmembers except Enrolled Students and the immediate families of members.

COMMITTEES

District Meeting Committee: K. B. McEachron, *chairman;* A. C. Stevens, vice-president, AIEE North Eastern District; R. G. Lorraine, secretary-treasurer, AIEE North Eastern District; F. N. Tompkins, chairman, committee on student activities, AIEE North Eastern District; A. Boyajian, R. M. Darrin, E. Huntington, F. R. Longley, H. A. McCrea, Victor Siegfried, and L. Wetherill.

Advisory Board: K. B. McEachron, *chairman;* A. Boyajian, F. F. Brand, V. E. Goodwin, V. M. Montsinger, I. H. Sclater, and E. D. Treanor.

Women's Entertainment: Mrs. V. E. Goodwin, *chairman;* Mrs. M. F. Beavers, Mrs. E. A. Evans, Mrs. G. P. Lehmann, Mrs. J. R. Meador, Mrs. J. L. Thomason, and Mrs. W. L. Young.

Technical Program: A. Boyajian, *chairman;* L. F. Blume, F. M. Clark, F. W. Godsey, Jr., V. M. Montsinger, E. T. Parsons, W. J. Rudge, H. R. West, and F. L. Woods.

Hotels and Registration: L. G. Hamilton, *chairman;* J. R. Barr, B. N. Bowers, R. A. Browne, T. M. Evans, H. S. Hubbard, J. E. Hutcheson, E. K. Kane, and G. P. Lehmann.

Entertainment: W. H. Cooney, *chairman;* M. F. Beavers, C. A. Beers, E. V. DeBlieux, C. W. Germeck, J. R. Meador, and P. N. Osborne.

Transportation and Trips: J. A. Roser, *chairman;* E. A. Elge, S. T. Maunder, A. Palme, C. C. Pilsbury, H. M. Towne, T. R. Walters, and J. H. Watkins.

Student Sessions: F. N. Tompkins, *general chairman;* L. Wetherill, *local chairman;* L. V. Bewley N. M. Case, H. S. Endicott, R. N. Kerchen, W. A. McMorris, and M. E. Scoville.

Publicity: C. A. Read, *chairman;* R. A. Browne, L. H. Burnham, L. W. Foster, W. D. Haylon, C. J. Kettler, and W. L. Lloyd.

Finance: G. W. Wade, *chairman;* J. L. Cantwell, and E. Stanley.

AIEE Section Organized at Muscle Shoals

Pursuant to authorization by the AIEE board of directors, the AIEE Muscle Shoals Section held its organization meeting in the visitors' room of the Wilson Dam power house February 18, 1938. Territory included in the new Section is: Alabama counties—Lauderdale, Limestone, Colbert, Lawrence, Morgan, Franklin, and Marion; Mississippi counties—Tishomingo, Itawamba, Alcorn, Prentiss, Lee; Tennessee counties—Hardin, Wayne, Lawrence, Giles, Lewis, and Maury. This is the Institute's 65th Section.

Officers elected to serve until August 1, 1938, are: B. B. Bessesen (A'17, M'27), superintendent of power, Muscle Shoals, plant, *chairman;* F. E. Bell (M'35), assistant construction engineer at Joe Wheeler Dam, *vice-chairman;* Margaret G. Coyne (A'37), secretary to superintendent of power, Wilson Dam, *secretary-treasurer;* and G. U. Mason (A'24), assistant electrical engineer, Tennessee Valley Authority, Pickwick Dam, B. M. Anthony (A'37), electrical engineer, TVA, Wilson Dam, Ala., R. C. Roberts (A'37), electrical engineer, TVA, Wilson Dam, and J. H. Christensen (A'37), assistant electrical engineer, Wilsom Dam power plant, *directors.*

Summer Convention to Be Held in Washington

The annual summer convention of the AIEE will be held in Washington, D. C., June 20–24, 1938, with headquarters at the Mayflower Hotel. The nation's capital, a center of historical interest and scenic beauty, situated on the banks of the Potomac, provides an ideal setting. Arrangements are being made by the committees for a business program combined with entertainment, trips, and sports, which will make for a pleasurable and profitable week.

In addition to the annual business meeting and the conference of officers, delegates, and members, 1 general session, 11 technical sessions, and 5 conference sessions tentatively have been scheduled. The technical sessions will deal with the subjects of fluorescent lighting, education, electronics, communication, power transmission, protective devices, electrical machinery, instruments and measurements, and selected subjects.

The personnel of the 1938 summer convention committee, appointed by President Harrison, is as follows: General committee—William McClellan, *honorary chairman;* H. W. Osgood, *chairman;* C. A. Robinson, *vice-chairman;* G. L. Weller, *secretary;* A. F. E. Horn, *treasurer;* F. A. Allner, R. C. Bailey, L. D. Bliss, J. V. B. Duer, N. E. Funk, W. B. Kouwenhoven, T. J. MacKavanagh, J. F. Meyer, J. S. Miller, H. S. Osborne, H. M. Southgate, and W. H. Timbie. Chairmen of subcommittees—Roland Whitehurst, *finance;* J. H. Stephens, *transportation;* W. J. Ellenberger, *registration and housing;* H. E. Way, *publicity;* A. O. White, *sports;* R. W. Prince, *inspection trips;* F. M. Defandorf, *technical programs;* S. K. Brown, *entertainment;* and R. C. Marshall, Jr., *women's entertainment.*

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Memorial Bridge which connects Alexandria, Va., with Washington, D.C., scene of the AIEE 1938 summer convention

Report on Telemetering Now Being Revised

To indicate the present status of development of devices used in telemetering and supervisory-control services, a revised report on telemetering, supervisory control, and associated communication circuits now is being prepared by a joint subcommittee of the AIEE composed of members of the committees on instruments and measurements and automatic stations; P. A. Borden (A'13, M'19) development engineer, Bristol Company, Waterbury, Conn., is chairman. The subcommittee's original report on this subject was completed in 1932, and essentially full text of that report (excepting extensive tabulations) was published in the September 1932 issue of ELECTRICAL ENGINEERING, pages 613–20.

Preparatory to revising the report, the subcommittee has sent questionnaires to all suppliers of equipment whose names are known to the subcommittee, and a large proportion of these have been completed and returned for compilation. Any manufacturers or distributors of this class of apparatus who have not yet received or returned questionnaires will assist the subcommittee materially by communicating with H. C. Koenig, chairman of the AIEE instruments and measurements committee, Electrical Testing Laboratories, 80th Street and East End Avenue, New York, N. Y.

New Recommendations for School Lighting Issued

A new booklet "American Recommended Practice of School Lighting," has been issued under joint sponsorship of the Illuminating Engineering Society and the American Institute of Architects and with approval of the American Standards Association. The booklet is the work of a committee that included eye-sight specialists, physicians, research workers, public health officials, architects, and engineers, and their recommendations constitute a comprehensive and thorough study of the subject. These new recommendations supersede those contained in an earlier booklet "Standards of School Lighting" published in 1932.

The primary purpose of this new edition has been to establish criteria of good illumination for the guidance of architects, engineers, school officials, and others interested in the conservation of children's vision and the efficiency of pupils and teachers. Successive sections cover the seeing problems confronting students and teachers; the factors that affect seeing and lighting; the problems involved in natural and artificial lighting of school rooms; how and when natural light may be augmented by artificial light under varying weather conditions; and a discussion of adequate wiring.

Single copies of the new recommendations are priced at 25¢ each, with quantity prices obtainable on request from the Illuminating Engineering Society, 51 Madison Avenue, New York, N. Y., or the American Standards Association, 29 West 39th Street, New York, N. Y.

Handbook of Chemistry and Physics. (2,096 pages, flexible fabrikoid, 4 by 6 1/2 inches, $6.) With some 50 pages of new material and more than 100 pages of previous material revised and brought up to date, the 22d edition of this useful compendium was issued recently by the Chemical Rubber Publishing Company of Cleveland, Ohio. An attempt has been made to include material "on all branches of chemistry and physics and the closely allied sciences that would be likely to find any extended use," although certain types of material of limited and highly specialized use have been excluded, of necessity. A large amount of "accurate, reliable, and up-to-date information," in the ever more closely related fields of chemistry and physics is presented in condensed form. Included are: 4 pages on poison antidotes, treatment for burns, scalds, and fire precautions; 302 pages of mathematical tables; 570 pages on chemical and physical properties and constants; 199 pages of general chemical tables; 195 pages on properties of matter; 156 pages on heat; 20 pages of hygrometric and barometric tables; 4 pages on sound; 108 pages of electricity and magnetism tables; 152 pages of light data; 187 pages of quantities and units; 145 pages of miscellaneous tables; and 30 pages of complete cross index.

Midwest Power Conference. Operated under private direction since 1926, The Midwest Power Conference in the future will be directed through the sponsorship of Armour Institute of Technology, with the co-operation of six state universities and local and national engineering societies, according to the preliminary program of the conference scheduled for April 13–15, 1938. This conference, to be held at the LaSalle Hotel, Chicago, Ill., has been planned to include addresses and conferences covering a wide variety of subjects ranging from the technical to the economic and into the sociological aspects of power progress. Information may be secured from L. E. Grinter, conference director, Armour Institute of Technology, Chicago, Ill.

Future AIEE Meetings

North Eastern District Meeting
Lenox, Mass. (Pittsfield Section)
May 18–20, 1938

Summer Convention
Washington, D. C., June 20–24, 1938

Pacific Coast Convention
Portland, Ore., August 9–12, 1938

Southern District Meeting
Miami, Fla., November 1938

Student Branches of South West District to Meet

The annual convention of AIEE Student Branches in the South West District will be held May 6–7, 1938 at Kansas State College, Manhattan. The program will include two technical sessions, a tour of a large cavalry school, and a banquet and dance on Friday, May 6; and on Saturday a technical session and a business meeting.

On Friday, the AIEE Kansas City Section will join the students in a joint meeting. Convention counselor will be Chester Russell (A'29, M'34) acting head, department of electrical engineering, University of New Mexico, Albuquerque.

Use of IES Name, Initials, and Insignia

The Illuminating Engineering Society recently issued a statement regarding the use of the society's name, initials, and insignia in publicity relating to IES lamps. The statement is expected to assist materially in eliminating the unauthorized use of the society's name, and in clarifying the society's position with respect to the lamp activity.

The society is a technical and research body with no commercial interest in the manufacture and sale of any lighting equipment. Specifications for mechanical, electrical, and illuminating features of portable lamps (not "fixtures") intended to supply utilitarian lighting have been made available to manufacturers, but there are no specifications or restrictions covering the decorative and artistic appearance of these lamps. The society requests that no use shall be made of the name, initials, or insignia in connection with the manufacture and sale of portable lamps unless these lamps have been built to meet the society's specifications and properly certified by the approved testing laboratories. It was pointed out that a lamp either meets the specifications or does not, and that there is no such thing as an "IES-type" lamp or an "IES principle." The society also forbids the use of its name or initials as part of the name of any company or association.

AIEE Atlanta Section Becomes Georgia Section

Upon recommendation of the AIEE Sections committee, the Institute's board of directors has authorized a change in name of the Atlanta Section to "Georgia Section," and the extension of its territory to include the entire state of Georgia. The membership of that Section will thereby be increased from some 80 to more than 100 members.

The Atlanta Section was organized January 14, 1904. H. N. Pye (A'15, M'27), chief engineer, South Eastern Underwriters Association, is present chairman of the Section; J. M. Flanigen (A'22, M'25), assistant superintendent, retail operation, Georgia Power Company, is secretary.

Carnegie Tech Receives Gift. A gift of \$300,000 from the Maurice and Laura Falk Foundation to the Carnegie Institute of Technology, Pittsburgh, Pa., for the support of a program of education and research in social relations was announced recently by R. E. Doherty (A'16, M'27) president of Carnegie Tech, and former chairman of the AIEE committee on education. In recognition of Mr. Falk's life-long interest in social problems, the foundation will establish at Carnegie a professorship of social relations, and the holder of this position will have charge of the new educational program. Mr. Falk, who established the foundation, pioneered the development of nonferrous industries in the Pittsburgh district and is active on the boards of several steel corporations.

A Pacific Coast Convention Attraction

Photo by George M. Henderson

A trip to Timberline Lodge on the slopes of Mount Hood, some 60 miles from Portland, Ore., may be included on the program of the AIEE 1938 Pacific Coast convention to be held in Portland. Convention dates, August 9–12, are almost a month earlier than those of previous recent conventions in order to provide better opportunity for combined vacation-convention trips.

To Institute Members Planning Trips Abroad

Members of the Institute who contemplate visiting foreign countries are reminded that since 1912 the Institute has had reciprocal arrangements with a number of foreign engineering societies for the exchange of visiting member privileges, which entitle members of the Institute while abroad to membership privileges in these societies for a period of three months and members of foreign societies visiting the United States to the privileges of Institute membership for a like period of time, upon presentation of proper credentials. A form of certificate which serves as credentials from the Institute to the foreign societies for the use of Institute members desiring to avail themselves of these exchange privileges may be obtained upon application to Institute headquarters, New York. The members should specify which country or countries they expect to visit, so that the proper number of certificates may be provided, one certificate being addressed to only one society.

The societies with which these reciprocal arrangements have been established and are still in effect are: Institution of Electrical Engineers (Great Britain), Société Française des Electriciens (France), Association Suisse des Electriciens (Switzerland), Associazione Elettrotecnica Italiana (Italy), Koninklijk Instituut van Ingenieurs (Holland), Verband Deutscher Elektrotechniker E. V. (Germany), Norsk Elektroteknisk Forening (Norway), Svenska Teknologforeningen (Sweden), Stowarzyszenie Elektrykow Polskich (Poland), Elektrotechnicky Svaz Ceskoslovensky (Czechoslovakia), The Institution of Engineers, Australia (Australia), Denki Gakkwai (Japan), and South African Institute of Electrical Engineers (South Africa).

Canadian Electrical Engineer Dead. James Stewart Arbuckle, prominent electrical engineer of Montreal, Que., Canada, died February 4, 1938. Mr. Arbuckle, a native of Pictou, N. S., was graduated from Pictou Academy in 1914, received an engineering diploma from Acadia University, and received the degrees of bachelor of science in electrical engineering and master of electrical engineering at McGill University and Cornell University, respectively. After graduating from Cornell he became associated with the Scintilla Magneto Company, New York, N. Y., remaining with that company until the American Brown-Boveri Electric Corporation was formed at Camden, N. J. At that time he was appointed consulting engineer on mercury-arc rectifiers for the American Brown-Boveri Corporation, and later went to the home offices of the company in Switzerland. Following one year as professor of electrical engineering at North Carolina State College, Mr. Arbuckle was associated briefly with the MacDonald Engineering Corporation, Philadelphia, Pa., as an efficiency engineer. Later he returned to the employ of the Brown-Boveri corporation when that organization established Canadian offices in Montreal. When the Swiss Electric Corporation, Ltd., was organized as a Canadian subsidiary of Brown-Boveri, he became chief

consulting engineer and general sales manager. Mr. Arbuckle was an associate of the AIEE from 1926 to 1932; he was a member of the Engineering Institute of Canada and of several other engineering societies.

Future Meetings of Other Societies

American Association for the Advancement of Science. Summer meeting, June 27–July 2, Ottawa, Can.

American Chemical Society. Semiannual meeting, April 18–21, Dallas, Tex.

American Institute of Chemical Engineers. Semiannual meeting, May 9–11, White Sulphur Springs, W. Va.

American Iron and Steel Institute. General meeting, May 26, New York, N. Y.

American Physical Society. 220th meeting, April 28–30, Washington, D. C.
221st meeting, June 1938, Pacific Coast.
222d meeting, June 24–25, Toronto, Ont., Can.

American Society for Testing Materials. Annual meeting, June 27–July 1, Atlantic City, N. J.

American Society of Civil Engineers. Annual spring meeting, April 20–22, Jacksonville, Fla.

American Society of Mechanical Engineers. Semiannual meeting, June 20–24, St. Louis, Mo.

Association of Iron and Steel Engineers. Annual spring conference, April 28–29, Baltimore, Md.

Canadian Electrical Association. Annual convention, June 22–24, Seigniory Club, Province of Quebec, Can.

Edison Electric Institute. Engineering committees, May 2–5, Chicago, Ill.
Annual convention, June 7–9, Atlantic City, N. J.

Electrochemical Society. Spring meeting, April 27–30, Savannah, Ga.

Institute of Radio Engineers. Annual convention, June 16–18, New York, N. Y.
Joint meeting with American Section of International Scientific Radio Union, April 29–30, Washington, D. C.

International Conference of Naval Architects and Marine Engineers. June 16–18, London, England.

International Engineering Congress. June 21–24, Glasgow, Scotland.

Midwest Power Conference. April 13–15, Chicago, Ill.

National Electrical and Radio Exposition. April 20–30, New York, N. Y.

National Electrical Manufacturers Association. May 15–20, Hot Springs, Va.

National Fire Protection Association. May 9–13, Atlantic City, N. J.

Northwest Electric Light and Power Association. Annual meeting, April 20–23, Vancouver, B. C.

Pacific Coast Electrical Association. Annual convention, May 26–27, San Francisco, Calif.

Society of Automotive Engineers. Annual meeting, June 12–17, White Sulphur Springs, W. Va.

Society of Chemical Industry. Annual meeting, June 20–22, Ottawa, Can.

Engineering Lectures Sponsored by Johns Hopkins

A series of six public lectures is currently being given (Wednesday evenings during March and April) by members of the electrical engineering staff of The Johns Hopkins University, Baltimore, Md. Offered from time to time, these lecture series deal with the practical phases of engineering problems, giving attention to working methods of design, construction, and operation, and especial characteristics of equipment and materials involved. Specifically intended for engineers, foremen, wiremen, and others making practical usage of various forms of electrical equipment, these lectures are open to the general public.

The current series deals with the general subject of electron tubes in engineering:

"Electrons, Their History and Properties," by Doctor J. B. Whitehead.

"Electron Tubes, Types and Characteristics," by Doctor F. Hamburger, Jr.

"Electronic Rectifiers," by Doctor J. H. Lampe.

"Electronic Control in Industry," by Doctor W. B. Kouwenhoven.

"The Electron Tube as Amplifier," by Doctor F. Hamburger, Jr.

"Electron Tubes in Radio Communication," by Doctor F. Hamburger, Jr.

Industrial Research Laboratories. A new edition of the National Research Council's bulletin, "Industrial Research Laboratories of the United States," has been made desirable by the recent increase in the number of research laboratories maintained by industrial concerns. Questionnaires have been sent to many concerns, and an appeal is made to those who are employed by firms which maintain laboratories to ascertain if a questionnaire has been received; a questionnaire may be obtained from the library, National Research Council, 2101 Constitution Avenue, Washington, D. C. No charge is made for an entry in the bulletin.

Noted Bridge Builder Dies. John Alexander Low Waddell, one of the best known of American bridge builders, died at New York, N. Y., March 3, 1938. Doctor Waddell was born at Port Hope, Ont., Canada, January 15, 1854, and was graduated from Rensselaer Polytechnic Institute in 1875. Throughout his career he received many honorary degrees from educational institutions in the United States and foreign countries. Following his graduation in 1875 he became engaged in railway work, following which, in 1881, he became chief engineer for Raymond and Campbell, bridge builders, of Council Bluffs, Iowa. In 1882 he went to Japan, where for four years he was professor of civil engineering at the Imperial University at Tokyo. Upon his return to the United States, Doctor Waddell opened a consulting-engineering office in Kansas City, Mo., continuing there in the practice of bridge engineering until 1920, when he moved his offices to New York. Doctor Waddell was acknowledged to be the originator of the modern vertical lift bridge, his first structure of that type being the Halstead Street Bridge, built in 1895 in Chicago, Ill. Twice he was consulted professionally by the Chinese government: In 1921 as the American member of an international commission for reviewing the designs for a proposed bridge over the Yellow River; and in 1929 as a consulting engineer to the Ministry of Railways.

AIEE New Orleans Section Inspects Sulphur Plant

On February 12, 1938, members of the AIEE New Orleans Section staged an inspection trip to the plant of the Freeport Sulphur Company at Port Sulphur, La. A group is shown here inspecting some of the material-handling equipment. This photograph was made available by A. S. Anderson, member of the New Orleans Section and District vice-chairman of the national membership committee.

Membership—

Mr. Institute Member:

Membership in the Institute confers upon the older men in the profession the privilege of becoming acquainted with and providing inspiration to the younger men, who must be continually coming in from the lower ranks. Similarly, those young men who join the Institute have the opportunity of becoming acquainted with the older men in the profession on a basis of friendship, co-operation, and common aims. It is a rare privilege to an older man to feel that he has helped a young man to greater effort and more praiseworthy endeavor as it is an inspiration to the younger man to have a personal acquaintance and friendship with the men who may otherwise be beyond his immediate hope of acquaintance.

Each member of the Institute can perform a valuable service to his profession by being instrumental in bringing these two groups of men—the old wise heads and the young men just starting out—to a closer relationship in friendship and co-operation by helping to bring them into the Institute.

Vice-Chairman District No. 6
National Membership Committee

A membership proposal form appears on page 18 of the advertising section of this issue

Procedure Handbook of Arc Welding Design and Practice, fifth edition ($1.50), recently announced by The Lincoln Electric Company, Cleveland, Ohio, contains 1,012 pages and a total of 1,243 illustrations. The Handbook is reissued each year to include all new data essential for most efficient use of arc welding in all its varied applications. Encyclopedic in scope, concisely written and profusely illustrated, the Handbook is a comprehensive arc welding reference guide. Written especially for the use of designers, engineers, architects, production managers, welding supervisors and operators, the Handbook contains a wealth of data of interest to draftsmen, steel fabricators and erectors, foremen, cost estimators, maintenance managers, shipbuilders, piping and pipe line contractors and students of welding.

Current Items From American Engineering Council

Technology, a Great National Resource

The eighteenth annual assembly of the American Engineering Council has approved the following findings of its special committee on scientific research legislation. In so doing, Council is believed to have voiced the sentiment of all of those engineers who realize that technology is our greatest national resource in terms of employment and economic stability and that fundamental research in the broad field of technology is essential to the advancement of modern civilization.

"Engineering and scientific research advances the standard of living by creating new products and discovering means for bringing old products within the purchasing power of more people. New industrial, commercial, and agricultural enterprises originating in such discoveries and inventions provide a sound basis for that continuous expansion of opportunity for employment of an increasing population which is so vital to economic stability.

"Co-ordinated and scientifically directed research is essential to the maintenance of adequate national defense, and persistent technical inquiry into the fields of biology, chemistry including food technology, public health, and medical science affords added protection against the natural and human hazards of a complicated civilization. In fact, all experience with research has proven it to be an investment in the public welfare.

"Engineers, individually and collectively, recognize their responsibility in the realm of technology and hold a profound desire to support all phases of research having a realistic objective, to the end that such valuable contributions to all important public service purposes may be attainable.

"American Engineering Council in its eighteenth annual assembly announced its belief and confidence in the following principles and requested its special committee on scientific research legislation to continue a study of possibilities for the Federal Government to aid research in the technology as well as in the pure and applied sciences.

"1. *Purpose of Research Activity.* Continued and aggressive attention must be given to many problems of a fundamental scientific and engineering nature by carefully planned research, to secure:

"*a.* The establishment of new industries;

"*b.* The expansion of existing industries;

"*c.* The increase of employment in industry, commerce, and agriculture;

"*d.* The wider distribution of the products of industry through reductions in cost, as a step toward higher standards of living especially for those of moderate and small income.

"*e.* The furtherance of public health and public safety by the applications of science in wisely planned engineering works and methods; and

"*f.* A firmer scientific and technical basis for national defense.

"2. *Federal Aid Necessary.* In order that the benefits of research may be most promptly realized by the public, the aid and encouragement of the Federal Government should be provided in all proper ways, including: (*a*) prosecution of more such fundamental research by present federal bureaus and establishments; (*b*) stimulation and assistance for research at educational institutions and such nonprofit-making laboratories as may be best prepared to serve the public; and (*c*) encouragement of all industrial and individual effort on research projects to the end that the maximum in useful results may be obtained at the earliest feasible date, regardless of the agency which sponsors or carries out the work involved.

"3. *Education Aid Required.* Since the training of persons fitted by knowledge and temperament to become research workers is an important responsibility of the public generally, it should be an important part of the duty of the Federal Government to aid present educational institutions in the enlargement and improvement of their facilities for graduate training of students in research methods and the preparation of such competent young people for a career in engineering and scientific research, both that of government and state agencies and in private employment.

"4. *No Interference With Private Enterprise.* Participation by the Federal Government in research projects should be so limited as not to interfere with present or prospective research of individuals, corporations, or educational institutions. If suitable precautions to this effect are not taken, the benefits of new public effort might be less than the benefits otherwise to be anticipated from the other research interfered with. Under wise technical management, the encouragement of research with federal funds need not interfere with any other type of scientific or engineering investigations."

Standards

Standardization of Bushings. In pursuance of a recommendation of the committee on co-ordination of Institute activities, the standards committee on February 25 appointed R. T. Henry as chairman of a subcommittee to consider the standardization of the electrical characteristics of bushings. Coupling capacitors are also to be included in the scope of work. The proposed subcommittee not only will include in its personnel, representatives of the several Institute committees involved, but also will be made up of essentially the same people as appear on the interested ASA committees. With this set-up it is felt that whatever the committee may eventually report will be satisfactory to all interests.

Rating and Recommendations on Operation. In a report by P. L. Alger presented to the standards committee on February 25, the suggestion was made that a review should be undertaken of the problems involved in the rating of electrical apparatus. In general such a review would consider such questions as effect of permissible temperature rises on life of apparatus, data now available on the life of insulation and new types of insulation, specified methods of temperature measurement, and continuous rating and its bearing on apparatus life. Data may well result from such an undertaking as will enable a user to determine how fast he is using up his apparatus. It was felt that perhaps the most effective way of arriving at definite results in regard to the problems involved would be through the holding of a symposium at an Institute meeting. Chairman Montsinger and Mr. Alger were delegated therefore to present at the next meeting of the technical program committee a complete picture of what the standards committee has in mind. The feasibility of such a symposium or other appropriate action can then be determined.

Automatic Stations. The sectional committee on power switchgear late in 1937 completed a revision of the "Standard for Automatic Stations." The basis of their work was the AIEE standard on the same subject of May 1930 which the Institute had submitted to the American Standards Association for action, together with a revision of the 1930 edition drawn up by the AIEE committee on automatic stations. The new standard, now under the sponsorship of the electrical standards committee, received approval of ASA as an American standard in October 1937. In addition to definitions, the new automatic-stations standard contains a complete list of standard device function numbers and a tabulation of the minimum protective device requirements for all of the principal classes of machines and equipment controlled by automatic switchgear. It has been found possible to assign definite numbers to all devices used in automatic stations on the basis of the function to be performed, these numbers being used uniformly by all manufacturers. The automatic stations standard, No. *C*37.2, is now available in pamphlet form at a cost of 40 cents per copy with the usual 50 per cent discount to AIEE members on single copies. Orders should be addressed to AIEE headquarters, attention of H. E. Farrer.

Oil Circuit Breakers. At the February 25 meeting of the standards committee of the Institute, approval was given to a revision of the present AIEE standard No. 19 for "Oil Circuit Breakers." This revision was submitted by the Institute's committee on protective devices. It was pointed out that a subcommittee of the sectional committee on power switchgear is at work on the development of an American standard for oil circuit breakers, but that because of the necessary procedure involved in obtaining approval, a considerable time would elapse before their work would be available to industry. As the AIEE report is identical, as far as it goes, with the proposed ASA standard and contains new material of vital interest to users, it seemed desirable to make it available by giving it formal AIEE approval and publishing as soon thereafter as possible. The report will therefore be submitted to the board of directors for action at their next meeting and then issued in pamphlet form without delay.

Relays. A standard for "Relays Associated with Power Switchgear" has been completed by the sectional committee on power switchgear. The basis of this new standard was the revised AIEE Report on Relays, No. 23, as submitted to ASA by the Institute. The standard is not limited to electrically operated relays, but also covers temperature relays, pressure relays, etc. However, it governs only relays directly associated with power switchgear. Relays associated with industrial control equipment, excitation or governor regulating equipment, and relays used for telephone, telegraph, traffic and railway signals, have to meet other requirements. For that reason they are not included. The new relay standard, No. *C*37.1, is now available in pamphlet form at a cost of 40 cents per copy with the usual 50 per cent discount to AIEE members on single copies. Orders should be addressed to AIEE headquarters, attention of H. E. Farrer.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

The Dielectric Circuit

Editor's Note: A faulty inference in the statement that "In some dielectrics a given charge of electricity may produce from one to ten times the force action that is produced in air," in the recent article by D. D. Ewing (*EE, Dec. '37, p. 1435*, third full paragraph, left-hand column) has been cited by William Kober (A'32) as a contradiction of Coulomb's law. Professor Ewing comments on the error as follows.

To the Editor:

There is a just reason for this criticism, because apparently I did not make the point under discussion clear. The paragraph criticized was not meant to refer to Coulomb's law, but rather to the experimental relation which I arbitrarily called the "fourth experimental law."

I had originally written in this paragraph an illustration drawn from the magnetic circuit, but in the interest of brevity I deleted it and in this process inadvertently used a wrong quantity. The sentence under discussion should have read "a given potential between capacitor plates" instead of "a given charge of electricity."

I was trying to emphasize the idea here that just as the insertion of an iron core in a solenoid will increase the magnetic pull, so will the insertion of certain materials in a dielectric circuit increase the force action between certain parts of the circuit. Apparently when I deleted my illustrative material I ruined the paragraph from the standpoint of clarity.

Very truly yours,
D. D. EWING (A'11, F'21)

(Professor of Electrical Engineering Purdue University, Lafayette, Ind.)

Registration of Engineers

To the Editor:

We wish to call attention to, and protest the publication of the letter or similar letter to that published on page 42 of January 1938 issue of ELECTRICAL ENGINEERING magazine, signed by Mr. Louis S. Leavitt.

Mr. Leavitt may, for some personal reason, not approve of the methods of handling the "registration" of engineers in his territory.

To condemn the whole proposition and persons and technique as a "racket" is certainly not an "ethical engineering report."

We question the ethics of publishing a letter in our engineering magazine containing the unsupported charges as written in the third paragraph of the above-mentioned letter.

We feel that the editors of ELECTRICAL ENGINEERING should not allow such a letter to be published unless there are very complete supporting data and it is intended that the AIEE, as an organization,* believes that the charges are justifiable. As a matter of fact, it is our understanding that the AIEE supports the idea of state registration laws.*

In justice to the engineers, who have given much of their time and ability toward the upbringing of the engineering provision of registration, we believe a retraction and statement of the position of the AIEE on this subject should be made.*

The paragraph referred to above is an example of the "unethical lowly ethics" supposedly condemned by Mr. Leavitt.

Very truly yours,

M. C. GOODSPEED (A'10, M'12)

(Safety Engineer, General Electric Company, Erie, Pa.)

***Editor's Note:** Attention is called to the conditions governing the publication of Letters to the Editor, as posted at the head of these columns. This department is merely a forum for the expression of readers' opinions on matters presumably of some current interest. The question of registration laws has been left as a matter of local option for the various sections.

To the Editor:

In the January 1938 issue of ELECTRICAL ENGINEERING there is published a letter from Louis S. Leavitt, which is supposed to be on the subject of "registration of engineers," however, the author states that he "knew practically nothing about its operation" and begins one sentence "I venture to guess." Mr. Leavitt then proceeds to inform your readers of the existence of "a board of politicians" and "nice fat political jobs" and suggests "that if real unsavory conditions have developed, a backfire aimed at removing the law from the books can be started and fanned into a real blaze." As no such law is in effect in the state of Massachusetts, it is evident that Mr. Leavitt is trying to dictate to engineers in other states how they should regulate the practice of their profession.

The writer has been an officer of the National Council of State Boards of Engineering Examiners for almost fifteen years and has had the privilege of being associated with the majority of the members of all of the state boards of engineering examiners or registration and he knows positively that they are not politicians, engineering or otherwise, and are not holding fat political jobs but are unselfish, intelligent gentlemen, serving the engineering profession and the public with very little remuneration or appreciation for their services except the satisfaction of a deed well done.

If Mr. Leavitt is sincere in his desire for information on the subject of the legal registration of engineers and will accept such information in a fair and unbiased manner, we hope he will read the four pamphlets we have mailed to him.

It is also suggested that Mr. Leavitt and your magazine might secure some pertinent facts from such members of AIEE as Doctor Charles F. Scott, past-president, AIEE; vice-president of the National Council of State Boards of Engineering Examiners and chairman of the Connecticut State Board of Registration for Professional Engineers and Land Surveyors; Dean P. H. Daggett, past-president of the National Council and chairman of its committee on accredited engineering schools; and Professor J. O. Kammerman, director of the National Council and a member of the South Dakota State Board of Engineering and Architectural Examiners.

It is assumed, of course, that in fairness to all concerned your magazine will give the same publicity to this communication and to the letters to you from Mr. F. O. Runyon and Mr. Willard S. Conlon as was given to the letter from Mr. Leavitt.

Very truly yours,

T. KEITH LEGARÉ

(Executive Secretary, National Council of State Boards of Engineering Examiners, Columbia, S. C.)

Pareto—Engineer, Economist, Sociologist

To the Editor:

In line with the current discussion of the place of the engineer in society, it is of interest to note the life and works of one who went from the practice of engineering to the study of economics and then of sociology. The life and works of Vilfredo Pareto are suggested as a guide in the enlarging concept of engineering because in his progression from mechanical matters to those of a sociological nature, he retained the scientific method which has been so outstandingly successful in the mechanical sciences.

Pareto was born in Paris, later moved to Italy, and attended the Polytechnic School at Turin. For twenty years he did engineering work relating especially to railways. At the age of forty-five he joined the University of Lausanne as professor of political economy. It was because he felt that economic theories were not alone sufficient to explain various phenomena in that field that he turned his attention to sociology. The results of his researches are contained in a translation entitled "The Mind and Society."

This theory is advanced as a scientific one, as using fundamentally the same method employed in the physical sciences. What is meant by scientific the author defines at length. His cornerstone in formulating scientific sociological laws he stresses is observation and experience. This is second nature to the engineer in regard to the mechanical sciences, but in economics and sociology there is great danger of overstepping the bounds of experience whether by the use of vague or abstruse terms or by the introduction of metaphysical elements. Pareto's theory is based on observation of facts, things that can be perceived by the senses. By an inductive process building up from the observation of facts, laws are formulated. A scientific law, according to the Paretan concept, is merely descriptive, a pithy summarization of a condition uniform to concrete situations of a specified kind. A scientific law derives from facts, has no validity otherwise, is only as accurate as the observations, and holds good only so long as no one turns up with an observation contrary to what the law describes. The things observed determine what science is developed. If one observes the effect of voltages on insulating materials he develops a theory of dielectrics, part of electrical science. Pareto observed the actions of men and developed sociological science.

To illustrate the definition two examples are given. A transmission line calculation is based on scientific laws which, though complex, are based on objective things. Back of these laws are standards such as a resistance of one ohm and processes which can be defined exactly and in any language. Every term used in the statement of these laws can be demonstrated by dispassionately going through a process or by pointing to a physical object which is a standard. Having made the calculation, the results, after the completion of the line, are measurable.

The law of evolution in so far as it describes a series of forms of life is scientific, but when there is implied a purpose or design behind such successive forms, then the theory transcends science as Pareto defines it simply because the alleged purpose or design, whatever our feeling about the matter, is not a matter of experience.

The method which Pareto employs is that which was used in the formulation of electrical laws, as an example, and he is careful to avoid the departures from experience which many theories represent. He admits frankly that there are other possible methods of studying the actions of men than his experimental method, states that his basis of observation and experience is simply axiomatic, and affirms his intention of being rigorously consistent with that basis throughout.

So much for Pareto's method. What is the theory itself? It can be only hinted at here. In the first place he divides the actions of men into two classes, those that are based on scientific or, in other words, experimental theories and which we will call logical actions, and those that are based on nonexperimental theories and which we will call nonlogical actions. An example of this distinction is the case of the ancient Greek sailors who in advance of a voyage made sacrifices to one of their gods and then rowed to their destination. We have observed that rowing is an effective means of causing a boat to move but have observed no connection between the making of sacrifices and the navigation of a boat. To the Greek sailors, however, both methods were necessary and effective for the making of a safe voyage. Rowing is to us a logical action, the offering of sacrifices a nonlogical one. It should not be inferred from the example that nonlogical actions are of trivial importance. In our own times there are many myths, although not referred to as such, which affect our society in important ways.

It is a human urge to try to give logical explanations to events including the actions of other persons, but much conduct that is made to appear as if persons were acting logically is in fact based on nonlogical principles. We might be inclined to treat the mythological beliefs of the Greek sailors as absurd prejudices and having thus done away with these beliefs only the logical

matter of rowing would remain. One cannot, however, thus sweep away such nonlogical conduct if he would understand the forces at work in society. We could appreciate the importance of nonlogical conduct if we should wonder what a future historian would have to say about the nineteen thirties.

Interests, or in other words, one's relation to his daily bread and other commodities, does not explain the whole story. It does not explain, for example, why one person gains his bread by the practice of medicine while another gains his through politics. Interests are important but not the sole elements in conduct.

Having determined that nonlogical actions were both common and important in society Pareto classified them. He found in certain groups of actions an element which was common to all individual cases within that group. And here we come back, by way of example, to the Greek sailors about whom it is easy for us to be objective. He observed that they made sacrifices to one of their gods in advance of a voyage. He observed other instances of the ancient Greeks propitiating their gods and treating them as real entities. Common to all these observations is the persistence of personifications, which he calls a residue although the name itself has little significance. Personifications come under a classification called the persistence of aggregates, which, in brief, reflects an attitude toward perpetuating organizations, abstractions, etc. Another broad classification reflects faith in combinations of things. It is here that the scientist is represented. In general, the persistence of aggregates group includes the conservatives, the combinations classification the inventors, devisers, and schemers. Other groups can be characterized as the impulse to action, sociability, and the integrity of the individual. Strictly these residues are what one gets by following a certain specified process just as power factor is what results when you read certain meters and make calculations in a given way. The residues have been described, however, as "inner drives."

One of these drives is that of rationalizing one's actions. Measures may be advance, for example, with the reason given that they are in accordance with "time honored custom," "sound principles," or the thoughts of "all intelligent persons." Such methods which have been devised to logicalize present or prospective actions cover a wide range, but searching analysis based upon the norm of experience can grant them no validity. The methods include the appeal to the authority of men or customs, accord with sentiment, and the use of ambiguous terms. An important clue to the residues or inner drives is afforded by these attempts to rationalize nonexperimental theories, such rationalization not being taken at their face value but merely viewed as occurrences.

The residues change slowly but the devices used to objectify them shift more rapidly. An example of this point is the State as expressing a concept which includes something intangible over and above an observable collection of individuals and a geographical territory. It may be a valuable concept but it does not come wholly within the realm of observation and experience. It is an objectification of sentiment by by means of a label. The concept of State has come down from ancient times but the attempts to make that concept objective have varied. In ancient times State was conceived as exemplifying Justice, was later accompanied with the social-contract theory, and in recent times was viewed as the asymptote of a progression—the family, the clan, the tribe, etc.

Pareto's works include descriptions of how residues function in society, what happens when their equilibrium is disturbed, the utility of the residues in society. He supports his findings here as in other parts of his theory with numerous examples.

The above has merely touched at points of this extensive work in an attempt to indicate the analysis and method rather than to summarize. The examples given have been for the purpose of clarity and have been deliberately taken as far from our present concerns as possible in order that they might be viewed objectively.

A few comments will be made on the nature of the theory. In the first place, it is not a mechanical analogy although the method used is the same in principle as that used in the physical sciences. It is not a glorification of Science in that it does not claim anything that cannot be supported by experience applied at every point. It promotes no "ism," no particular social system. Its relation to psychology is analogous to a person taking a value for transformer efficiency and using that in computing the efficiency of a transmission line including transformers. He does not need to know all the ins and outs about the transformer efficiency beyond the division between core and copper losses. Pareto's sociology is analogous to the over-all transmission calculation, the detailed computation or measurement of the transformer efficiency to psychology.

The theory contains many points which are not new as isolated observations but what is new is their correlation and combination in a significant way. The laws developed have the value of epitomizing otherwise complex phenomena as alternating current laws summarize what, except for these laws, would be isolated unrelated data.

If the engineer is to understand more of social forces, he can do so on his own objective experience basis by using Pareto as a guide. The engineer is in the position of having had scientific training and is familiar with the experimental method. He is fitted by training to distinguish that which is known on the basis of experience from that which is not, two realms of thought and feeling which are constantly being confused although each has its proper sphere. The engineer is noted for his consistent results in physical matters. Careful consideration should be given to social engineering if he is to be similarly effective in that field.

Very truly yours,

Everett L. Sweet (A'25)

(Central Hudson Gas and Electric Corporation, Poughkeepsie, N.Y.)

Personal Items

G. H. Bucher (M'24) executive vice-president of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., recently was elected president of the company. Mr. Bucher was born July 24, 1888, at Sunbury, Pa., and is a graduate (1909) of Pratt Institute. Following his graduation he was employed by the Westinghouse company at East Pittsburgh as a graduate student. In 1911 he was transferred to the export department of the company in New York, N. Y., and in 1920 was appointed assistant to the general manager of the Westinghouse Electric International Company. In the following year Mr. Bucher was made assistant general manager which position he held until 1932, when he was elected vice-president and general manager. In 1934 he was elected president and general manager of the Westinghouse Electric International Company, and in the following year became vice-president of the Westinghouse Electric and Manufacturing Company. He was appointed executive vice-president in 1936.

W. H. Sammis (A'20) assistant to the vice-president of the Commonwealth and Southern Corporation, New York, N. Y., recently was elected a vice-president and director of the corporation. Mr. Sammis was born at Hempstead, N. Y., June 28, 1896, and was graduated from Columbia University in 1917 with a degree in electrical engineering. Following his graduation he became a machinist and ensign in the United States Navy, serving as an instructor at the naval training school at Great Lakes, Ill. After serving one year as an instructor at Columbia University Mr. Sammis became a member of the Consumers Power Company, Jackson, Mich., in 1920, and six months later was made assistant electrical engineer, subsequently becoming power sales engineer. In 1924 he became affiliated with C. H. Tenney and Company of Boston, Mass., for power sales and rate-analysis work on the properties of that company located in New York and New England. In the following year he returned to the Consumers Power Company as assistant to the general manager, and in 1929 became assistant to the president. In 1932 he was made a vice-president and director of the company and was elected president of the Pennsylvania Power Company in 1936. Mr. Sammis still retained his positions in the Consumers Power Company and the Pennsylvania Power Company both of which are operating units of the Commonwealth Southern Corporation.

H. C. Dean (A'12, F'30) vice-president of the New York and Queens Electric Light and Power Company, Long Island City, N. Y., recently was elected vice-president

and assistant to the vice-chairman of the board, in which position he will assume the duties of local administrative officer of the company. Mr. Dean was born at Canton, S. D., March 25, 1888, and was graduated from the University of Illinois in 1909 with the degree of bachelor of science in railway electrical engineering. After three years with the Public Service Company of Northern Illinois he entered the employ of the City of Chicago, and in 1914 became electrical engineer in charge of the Bureau of Engineering and Construction in the Department of Gas and Electricity. In 1916 he became affiliated with the New York and Queens Electric Light and Power Company, with the position of assistant to the vice-president, and in the following year Mr. Dean was appointed general superintendent in charge of the engineering, construction, operation, and transportation departments of the company, continuing in this position until his appointment as vice-president in 1934. In 1935 he was elected a director of the company and also became a member of its executive committee. Mr. Dean was a member of the Institute's Board of Examiners from 1933 until 1937 and served as chairman during 1936–37. Until recently he was a member of the committee on legislation affecting the engineering profession and served on the power transmission and distribution committee from 1929 until 1932.

G. H. BUCHER

W. P. HOLCOMBE

F. A. MERRICK

Sir John Snell (A'06, F'12) former chairman of His Majesty's Electricity Commissioners, London, England, has been awarded the Faraday Medal of the Institution of Electrical Engineers (Great Britain). The medal is awarded not oftener than once a year for notable scientific or industrial achievements, or for conspicuous service rendered the advancement of electrical science. Sir John was born December 15, 1869, at Saltash, Cornwall, and was educated at King's College in London. For three years he was assistant engineer for Crompton and Company, in which position he became engaged in central-station work in both England and Sweden. He then became chief assistant to a consulting engineer for three years before being appointed resident engineer for the Borough Council in London. Sir John was borough electrical and tramways engineer to the Sunderland Corporation for nine and one-half years before becoming a partner in the firm of Preece, Cardew, and Snell in 1906. He continued in private consulting work until 1918. During 1914–15 he was president of the Institution of Electrical Engineers, and from 1926 until 1931 was a vice-president of the Institution of Civil Engineers. Sir John is a past member of the British Advisory Council for Scientific and Industrial Research, has been chairman of the water power resources committee, and chairman of the committee on electroculture of the Ministry of Agriculture. He retired as chairman of the Electricity Commission at the end of 1937.

W. P. Holcombe (A'06, M'13) vice-president of the Brooklyn Edison Company, Inc., Brooklyn, N. Y., recently was elected vice-president and assistant to the vice-chairman of the board, in which position he will assume the duties of the local administrative officer of the company. Mr. Holcombe was born at Mobile, Ala., November 20, 1875, and was graduated from Centenary College with the degree of bachelor of science in 1896. Later he enrolled in the graduate school of electricity and mechanics at Alabama Polytechnic Institute, but his graduate studies were interrupted by his enlistment in the United States Army at the beginning of the Spanish-American War. After the War he became affiliated with the Mobile Electric Company, with which he remained until 1903, when he went to St. Louis, Mo., with the Wesco Supply Company. Later Mr. Holcombe joined the sales department of the Frank Adam Electric Company of that city. In 1919 he went to Detroit as engineer and partner in an electrical contracting company, and in 1920 he joined the Brooklyn Edison Company as purchasing agent. Mr. Holcombe was elected vice-president in 1926.

F. A. Merrick (A'07) since 1929 president of the Westinghouse Electric and Manufacturing Company, recently was elected vice-chairman of the board. Mr. Merrick was born at Lambertville, N. J., and was educated at Lehigh University, where he was graduated in 1891 with a degree in electrical engineering. In the same year he entered the employ of the Thomson-Houston Electric Company and served successively as a consultant with the engineering firm of Blood and Hale, manager and chief engineer of the Steel Motors Company. When the Steel company was absorbed by the Westinghouse Company in 1902, Mr. Merrick was retained by the latter. In the following year the Canadian Westinghouse Company, Ltd., was formed and Mr. Merrick was sent to Hamilton, Ont., to take charge of the construction of the company's plant there. He remained as superintendent and later became successively manager, vice-president, general manager, and director. During the World War he was placed in charge of the factory of the New England Westinghouse Company at Chicopee Falls, Mass. After the War Mr. Merrick was located in London, England, for two years as special representative of the Westinghouse Electric International Company, after which he returned to Canada to resume his duties as vice-president and general manager of the Canadian Westinghouse Company. He was elected president of the Westinghouse Electric and Manufacturing Company in 1929.

W. H. SAMMIS

Bachrach

H. C. DEAN

SIR JOHN SNELL

C. C. Curtis (M'23) for the last eight years personnel director of the Engineers Public Service Company at the Stone and Webster Service Corporation, New York, N. Y., has been elected president of the Savannah Electric and Power Company, Savannah, Ga. Mr. Curtis was born March 27, 1883, at Battle Creek, Mich., and was graduated from the University of Michigan with the degree of bachelor of science in mechanical engineering in 1907. Immediately following his graduation he became associated with the Stone and Webster company as student engineer on a power-station construction project at Lowell, Mass., later going to Pawtucket, R. I.

in the same capacity. For almost five years he served as light and power superintendent and later as general superintendent and manager of the Ponce Railway and Light Company at Ponce, Porto Rico. He then returned to New England to the Stone and Webster Boston, Mass., offices, but in 1913 he went into the field again as an executive for the Lake Ariguanabo Company in Cuba. Later in the same year Mr. Curtis returned to the United States and was made superintendent of the Houghton County Electric Light Company, Houghton, Mich., where he remained until 1915. From 1915 until 1918 Mr. Curtis was superintendent of the light and power department of the El Paso Electric Company, El Paso, Tex., before going to Sydney, Nova Scotia, as manager of the Cape Breton Electric Company, Ltd. From 1923 to 1931 he was vice-president and manager of the Fall River Gas Works and then was transferred to the division managership of the Puget Sound Power and Light Company, Seattle, Wash. He became personnel director for Stone and Webster in 1931.

Joseph Slepian (A'17, F'27) consulting research engineer for the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed an associate director of the Westinghouse research laboratories. Doctor Slepian was born at Boston, Mass., in 1891, and received the degrees of bachelor of arts, master of arts, and doctor of philosophy from Harvard University. After a year of study in Germany and France he was appointed to the faculty of Cornell University as an instructor in mathematics, remaining there until he entered the student course of the Westinghouse company in 1916. He joined the research department in 1917, shortly thereafter being given charge of the development of electrolytic capacitors. In 1921 Doctor Slepian devised the autovalve lightning arrester, and as a result of his researches on arcs later produced the deionizing circuit breaker. He holds numerous patents and has written many Institute papers. Doctor Slepian has been a member of the Institute's basic sciences committee since 1924, and was chairman of that committee during 1933–34. He has served also as a member of the committee on electric welding and the technical program committee.

C. A. Powel (M'20, director) manager of the central station engineering department of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed manager of the newly formed industry engineering department, which has been established to centralize electrical engineering activities of the company relating to central station and industrial power problems. Mr. Powel was born at Rouen, France, July 29, 1884, and was graduated with the diploma of electrical engineer from the Bernese Technical College (Switzerland), following which he entered the application engineering department of Brown, Boveri, and Company in Baden, Switzerland. Six years later he was sent to Japan as resident engineer for that firm and remained there until 1915, when he returned to England and joined the civil branch of the Ordnance Department, during the World War. Following the War Mr. Powel moved to Pittsburgh and joined the Westinghouse company as a general engineer. He is a director of the Institute and a member of the committees on power generation and application to marine work.

W. H. Cole (A'12) for 25 years superintendent of the street engineering department of the Edison Electric Illuminating Company of Boston, Boston, Mass., recently retired from active service. Born June 1, 1875, at Cambridge, Mass., Mr. Cole entered the testing department of the General Electric Company, Lynn, Mass., in 1895, where he remained for three years before becoming chief electrician of the Newton and Watertown Gas Lighting Company at Newton, Mass. In 1906 he became superintendent of the electrical department of the Waltham Gas Light Company, Waltham, Mass., remaining there until 1909. In the latter year he was appointed Waltham agent for the Edison Electric Illuminating Company of Boston, and a few months later was appointed superintendent of the street engineering department and transferred to the Boston offices of the company. Mr. Cole served for many years on the cable committee and as chairman of the underground systems committee of the former National Electric Light Association. He was active also in committee work of the Association of Edison Illuminating Companies.

C. D. Poey (M'37) illuminating engineer and manager of the lighting bureau of the Consolidated Edison Company of New York, Inc., New York, N. Y., recently resigned to become chief engineer of the illuminating division of the Greist Manufacturing Company, New Haven, Conn. A native (1897) of Flushing, N. Y., Mr. Poey attended Yale University and Stevens Institute of Technology before becoming a lieutenant (junior grade) in the United States Navy during the World War. In 1919 he became a sales engineer for the Benjamin Electric and Manufacturing Company, New York, N. Y. Two years later he became affiliated with the Consolidated Edison systems as illuminating engineer for the New York and Queens Electric Light and Power Company. Mr. Poey has been active in committee work of the Illuminating Engineering Society, and has presented many papers on lighting and its applications before that society.

R. D. Evans (A'21, M'26) central station engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and current chairman of the Institute's committee on power transmission and distribution, recently was appointed a consulting transmission engineer for the company. Mr. Evans was born in 1892 at Spring Water, Wis., and was graduated from the University of Oklahoma in 1914, following which he entered the employ of the Westinghouse Company as a general engineer. He has been affiliated with that company continuously, and has done much original work in studies of power generation and transmission, a-c railway engineering, electric furnaces, and inductive co-ordination. Mr. Evans has served the Institute as a member of the power transmission and distribution committee since 1924, and was a member of the committee on communication from 1924 until 1934.

A. A. Low (M'37), vice-president of the Consolidated Edison Company of New York, Inc., New York, N. Y., and of Brooklyn Edison Company, Inc., Brooklyn, N. Y., recently was elected vice-president of the New York and Queens Electric Light and Power Company, Long Island City, N. Y. Mr. Low was born at Saratoga Springs, N. Y., in 1889, and received the degree of bachelor of arts at Yale University in 1911. He entered the public utility field in 1928 as organizer and president of the Old Forge (N. Y.) Electric Company. In 1931 he became affiliated with the Utica (N. Y.) Gas and Electric Company as executive vice-president, which position he held for three years before being elected president of that company in 1934. Mr. Low became identified with the Brooklyn Edison Company in 1936 as executive vice-president in responsible charge of operations.

C. F. Wagner (A'20, M'27) central station engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., recently was appointed a consulting transmission engineer. Mr. Wagner was born in 1895 at Pittsburgh, Pa., and was graduated from Carnegie Institute of Technology in 1917 with the degree of bachelor of science in electrical engineering. Immediately following his graduation he joined the Westinghouse company as an assistant in the engineering laboratory. Since 1924 much of his work has been concerned with power transmission, particularly problems in stability. Mr. Wagner has presented several papers before the Institute and was a member of the committee on power transmission and distribution from 1930 until 1932.

G. E. Hulse (M'22) chief engineer of the Safety Car Heating and Lighting Company, New Haven, Conn., recently was elected treasurer of the American Society of Refrigerating Engineers. Mr. Hulse was born at Bellport, N. Y., in 1877, and was graduated from Stevens Institute of Technology in 1902 with the degree of mechanical engineer. He became affiliated with the Safety Car Heating and Lighting Company at Jersey City, N. J., immediately following his graduation, and has held successively the positions of assistant engineer, engineer of tests, and chief engineer.

Douglas Robertson (A'27) central station engineer for the Canadian General Electric Company, Ltd., Vancouver, B. C., Canada, has been appointed British Columbia

branch manager of that company, with headquarters in Vancouver. A native (1896) of Toronto, Ont., and a mechanical engineering graduate (1918) of the University of Toronto, Mr. Robertson became associated with the Manitoba Power Company in 1921. A year later he joined the engineering staff of the Winnipeg Electric Company, and in 1924 joined the Winnipeg staff of the Canadian General Electric Company, Ltd. In 1926 he was transferred to the Vancouver office, where he has remained since that time.

Bernard Lester (A'06, M'13) assistant industrial sales manager, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., recently was appointed manager of the newly formed resale department of the company. Mr. Lester was born in England, in 1881, and was graduated from Haverford College with the degree of bachelor of science. He entered the employ of the Westinghouse Electric and Manufacturing Company in 1906 as assistant manager of the industrial and power division of the sales engineering department, and has been closely identified with the sales work of that organization for more than 30 years.

A. C. Monteith (A'25) general engineering department Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has become engineering manager of the central station section of the company. A native (1902) of Brucefield, Ont., Canada, Mr. Monteith has been associated with the Westinghouse company since he was graduated from Queens University in 1923. He completed the Westinghouse graduate student course in 1924 and at once became engaged in central station engineering work.

Byron Eldred (F'30) consulting research engineer, New York, N. Y., has been elected president of the Engineers' Club (New York) for the year 1938. Doctor Eldred is a graduate of Dartmouth College in the class of 1896, and has been engaged as a research consultant in New York since 1903. He is a member of The American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers.

G. E. Stoltz (A'13, M'19) Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has been appointed manager of the metal working section of the company. Born at Gettysburg, Ohio, in 1886, Mr. Stoltz was graduated from The Ohio State University in 1909, and immediately enrolled in the apprentice course of the Westinghouse company. Since 1911 he had been engaged in the application of electrical apparatus in steel mills.

Gano Dunn (A'91, M'94, F'12, past-president life member) president of the J. G. White Engineering Corporation, New York, N. Y., recently was elected a director of the Radio Corporation of America. A biographical sketch of Mr. Dunn appeared in the January issue of Electrical Engineering, page 44.

O. W. Towner (A'28, M'35) has resigned as a member of the technical staff of the Bell Telephone Laboratories, Inc., New York, N. Y., to become chief radio engineer of the Louisville Times Company, Louisville, Ky. For the last ten years Mr. Towner has been supervising the erection of radio transmitting and receiving equipment throughout the United States.

L. M. Nelson (M'34) superintendent of the water and light department of the City of Hastings, Nebr., since 1933, recently resigned to become superintendent of the electricity utility system at Rochester, Minn.

Obituary

Alfred Warner Dater (A'23) vice-chairman of the board of directors, The Connecticut Power Company, Stamford, died February 21, 1938. Mr. Dater was born in Brooklyn, N. Y., August 23, 1872, and was graduated from Yale University in 1895 with the degree of bachelor of philosophy. His first position was with The Pennsylvania Railroad at Fort Wayne, Ind., as a machinist's helper. In 1897 he became assistant general manager of the King's County Electric Light and Power Company, Brooklyn, N. Y. During the following year that company acquired the Edison Electric Illuminating Company and Mr. Dater was elected treasurer of the combined companies, which office he held until he went to Stamford in 1903 to organize and become vice-president and treasurer of the Oven Equipment and Manufacturing Company. In 1904 he became affiliated with the Stamford Gas and Electric Company as treasurer and a director. In 1911 Mr. Dater was elected vice-president of the company, and six years later became president. When the Stamford Gas and Electric Company merged with the Connecticut Power Company in 1936, he was elected vice-chairman of the Board of Directors of The Connecticut Power Company, of which he was a director, and chairman of the Stamford Gas and Electric divisional committee. During the World War he was associated with the United States Fuel Administration and the Naval Advisory Board.

Edwin Partridge Harder (A'03, M'34) electrical engineer for the Buffalo, Niagara, and Eastern Power Corporation, Buffalo, N. Y., died February 14, 1938. Mr. Harder was born October 13, 1873, at Catawissa, Pa., and was graduated from Pennsylvania State College with the degree of bachelor of science in electrical engineering in 1895. Immediately following his graduation he entered the employ of the Central Electric Company, Philadelphia, Pa., later becoming foreman of construction for the Borough of Manhattan Electric Company and the New York Heat, Light, and Power Company. Following a brief affiliation with the New York Edison Company, he became superintendent of stations and inside construction for the Cataract Power and Conduit Company, Buffalo, N. Y., in 1901, remaining there until 1915, when that company was merged with the Buffalo General Electric Company, and Mr. Harder was transferred to the engineering department as an electrical engineer. A further merger in 1929 transferred Mr. Harder to the engineering department of the Buffalo, Niagara, and Eastern Power Corporation Division of the Niagara Hudson Corporation, where he was placed in immediate responsible charge of the engineering work and drafting for several 25-cycle stations. Mr. Harder was particularly active in the affairs of the Institute's Niagara Frontier Section, having held several offices including the Section chairmanship during 1934–35.

Byron Briggs Brackett (A'97, M'13, F'35, member for life) director of educational broadcasting in charge of radio station KUSD, University of South Dakota, Vermillion, died December 12, 1937. Doctor Brackett was born August 13, 1865, at Ira, N. Y., was graduated in electrical engineering from The Johns Hopkins University in 1895, and received the degree of bachelor of philosophy from the same institution in 1897. In 1903 he was appointed professor and head of the departments of physics and electrical engineering at Clarkson College of Technology, where he remained until 1909, when he became professor of electrical engineering at South Dakota State College of Agriculture and Mechanic Arts, Brookings. In 1923 Doctor Brackett became professor and head of the department of electrical engineering of the University of South Dakota, and in 1931 was appointed director of educational broadcasting sponsored by the University. He was the first chairman of the South Dakota State Board of Engineering and Architectural Examiners to license professional engineers, and was a past-president of the South Dakota Academy of Sciences. He was a fellow of the American Association for the Advancement of Science, and a member of Sigma Xi and Phi Beta Kappa.

Joseph Harold Paget (A'14), manager of engineering and operation of the Carolina Power and Light Company, Raleigh, N. C., died February 2, 1938. Mr. Paget was born June 29, 1888, at Boston, Mass., and attended Lowell Institute. In 1906 he entered the Lynn works of the General Electric Company, and except for one year with the Edison Electric Illuminating Company of Boston, remained with the General Electric Company until 1913. He then joined the engineering staff of the British Columbia Electric Railway Company at Vancouver as meter and relay engineer. In 1918 he was appointed plant engineer for the company, having charge of generating plants and substations. In 1919 Mr. Paget was engaged by the Mexican Light and Power Company, Mexico City as an electrical engineer. His next position was with the Great Western Power Company, which is now a part of the Pacific Gas and Electric Company, San Francisco, Calif.,

where he was assistant engineer in charge of design and construction of high-voltage automatic substations and the entire relay system. Mr. Paget became affiliated with the Carolina Power and Light Company in 1925 as superintendent of power, and was appointed manager of engineering and operation in 1935. During 1931–32 Mr. Paget served as chairman of the AIEE North Carolina Section.

James F. Schnabel (M'37) chief engineer of the Euclid Electric and Manufacturing Company, Euclid, Ohio, died in December 1937. Mr. Schnabel was born at Petersburg, Ohio, December 19, 1881, and was graduated from Poland (Ohio) Union Seminary in 1900. In 1901 he was employed by the Economy Electric Company, Warren, Ohio, as a lamp tester and later in the same year became a draftsman for the Harris Automatic Press Company, Niles, Ohio, before taking a similar position with the Republic Iron and Steel Company, Youngstown, Ohio, in 1903. In the following year he became a draftsman for the Electric Controller and Supply Company, Cleveland, but later was transferred to the sales engineering department, and in 1911 was appointed assistant sales engineer for the company. In 1926 Mr. Schnabel transferred his affiliation to the Clark Controller Company, Cleveland, where he became engaged in research work resulting in several patents pertaining to improvements in motor control and dynamic braking of hoists. He was appointed chief engineer of the Euclid Electric and Manufacturing Company in 1933. Mr. Schnabel was active in the AIEE Cleveland Section and during 1925–26 was Section secretary.

Winfred Morrill (A'34) associate electrical engineer, procurement division, United States Treasury Department, Washington, D. C., died recently. Mr. Morrill was born October 22, 1888, at Sutton, Mass., and was graduated from New Hampshire State College in 1911 with the degree of bachelor of science. Following a brief affiliation with the Western Union Telegraph Company, he became an electrician for Stone and Webster in 1912. Between 1914 and 1920 Mr. Morrill held various engineering positions with the Stone and Webster company and with several manufacturing organizations. In 1922 he was made electrical foreman for the Stone and Webster company, in which position he assisted in several construction projects throughout the United States. In 1932 Mr. Morrill was transferred to the Potomac Electric Power Company, Washington, D. C., returned briefly to the employ of Stone and Webster in the same year, and in the following year entered the employ of the Virginia Electric and Power Company, Williamsburg. He was appointed to the United States Treasury Department in 1935.

Joseph Auken Thaler (A'03, M'08, F'13) professor and head of the department of electrical engineering at Montana State College, Bozeman, died March 4, 1938. Professor Thaler was born September 29, 1864, at Koessen, Austria, and was graduated from the electrical engineering course of the University of Minnesota in 1900. Following his graduation he was appointed an instructor in mechanical engineering at Montana State College in 1901, going to Purdue University as an instructor in mechanics in 1902. He returned to Montana the next year to teach electrical engineering, and was appointed head of that department. Professor Thaler sponsored the installation of the AIEE Student Branch at Montana State College in 1907, and served as counselor of that Branch for more than 30 years. He was active in initiating the AIEE Montana Section and was its first chairman, holding that office for three years following the establishment of the Section in 1931. Professor Thaler was a member of Sigma XI, Tau Beta Pi, the Society for the Promotion of Engineering Education, and the Montana Society of Engineers.

Henry William Taylor (A'07) chief turbogenerator designer for the British Thomson-Houston Company, Ltd., Rugby, England, died February 1, 1938. Mr. Taylor was born in London, November 2, 1883, and received his technical education in mechanical and electrical engineering at the City of London Guild's Technical College. In 1903 he became technical assistant to Doctor S. P. Thompson (A'97, HM'14) and held that position for three years before becoming a designing engineer for the British Thomson-Houston Company. He served that organization for almost 30 years, first as a designing engineer, and later as an engineer in the turbogenerator department and as chief of that department.

Benjamin Robinson (A'20) power house operator and electrician for the Packard Motor Car Company, Detroit, Mich., died December 15, 1937. Mr. Robinson was born March 16, 1881, at Yorkshire, England, and gained his technical training by attending several trade electrical schools in England. For 16 years he was an electrician for the Scoville Manufacturing Company, Waterbury, Conn.; later he became successively assistant to the chief electrician and chief electrician for the Bristol Brass Corporation, Bristol, Conn. Mr. Robinson became affiliated with the Packard Motor Car Company in 1930.

Francis Elliot Cabot (A'95, member for life) retired secretary and engineer of the Boston Board of Fire Underwriters, Boston, Mass., died January 7, 1938. Mr. Cabot was born in Brookline, Mass., in 1859, and was graduated from Harvard University in 1880. For a time he was a consulting electrical engineer in Boston, and served the Underwriters' Board for 43 years.

Hugh Lesley (A'02, member for life) engineer for The Electric Storage Battery Company, Philadelphia, Pa., died in February 1938. Mr. Lesley was born in Philadelphia, August 10, 1867, and was graduated from Haverford College with the degree of bachelor of science. From 1888 until 1899 he filled various engineering positions with the Accumulator Company and the Planté Company. He became engineer in charge of the operating department of The Electric Storage Battery Company in 1899, and his association with that company was unbroken for almost 40 years.

William George Rogers (A'07) engineering department, The Electric Storage Battery Company, Philadelphia, Pa., died February 3, 1938. Mr. Rogers was born in Philadelphia, June 3, 1879, and attended Drexel Institute. In 1899 he entered the employ of the Philadelphia Electric Company as a draftsman. Later he was transferred to the electrical construction department, and in 1906 was placed in charge of maintenance and operation of central power plants and substations of that company. He joined the engineering staff of The Electric Storage Battery Company in 1910.

Membership

Recommended for Transfer

The board of examiners, at its meeting on March 17, 1938, recommended the following members for transfer to the grade of membership indicated. Any objections to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Campbell, A. B., engineer, Edison Electric Institute, New York, N. Y.
Craig, P. H., vice-president and director of laboratory, Invex Corporation; consulting engineer, Roller Smith Company, Bethlehem, Pa.
Heitzler, A. H., superintendent, electrical department, Public Service Company of Colorado, Denver.
Jones, A. L., district manager, General Electric Company, Denver, Colo.
Lewis, W. W., transmission engineer, central station department, General Electric Company, Schenectady, N. Y.
McClellan, L. N., chief electrical engineer, United States Bureau of Reclamation, Denver, Colo.
6 to Grade of Fellow

To Grade of Member

Abigail, E. W., system control engineer, Shanghai Power Company, Shanghai, China.
Ballenger, W. M., engineering department, General Electric Company, Chicago, Ill.
Brainard, D. E., section head in motor and generator engineering department, General Electric Company, Schenectady, N. Y.
Brownlee, W. R., system relay engineer, The Tennessee Electric Power Company, Chattanooga, Tenn.
Bukey, N. J., engineer, underground cable construction, Cincinnati Gas and Electric Company, Cincinnati, Ohio.
Canfield, W., engineer, Public Service Company of Oklahoma, Tulsa.
Glenn, T. G., assistant district engineer, General Electric Company, Chicago, Ill.
Hinckley, A. D., assistant to dean of faculty of engineering, and instructor in electrical engineering, Columbia University, New York, N. Y.
Howard, Otis, assistant general superintendent, Oklahoma Gas and Electric Company, Oklahoma City.
Ickis, L. S., assistant district engineer, General Electric Company, Denver, Colo.
Ide, C. E., vice-president and general manager, East Tennessee Light and Power Company, Bristol, Tenn.
Jolliffe, J. P., assistant engineer, electrical, United States Army, Corps of Engineers, Portland, Ore.
LaCauza, F. E., assistant professor of electrical engineering, postgraduate school, United States Naval Academy, Annapolis, Md.
Lindsay, R. W., chief engineer, Mountain States Telephone and Telegraph Company, Denver, Colo.

McCallum, V. E., supervising design engineer, Commonwealth Edison Company, Chicago, Ill.
Munk, Gunnar, designer, Union Carbide Company, Niagara Falls, N. Y.
Olving, B. G., development engineer, The Safety Car Heating and Lighting Company, New Haven, Conn.
Reed, O. P., district superintendent, Cheyenne Light, Fuel, and Power Company, Cheyenne, Wyo.
Smith, H. E., assistant electrical engineer, Philadelphia and Reading Coal and Iron Company, Pottsville, Pa.
Stewart, H. M., electrical engineer, Humble Oil and Refining Company, Baytown, Texas.
Warren, P. L., vice-president, Royal Electric Manufacturing Company, Chicago, Ill.

21 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before April 30, 1938, or June 30, 1938, if the applicant resides outside of the United States or Canada.

United States and Canada

Achenbach, J. C., RCA Manufacturing Company, Inc., Camden, N. J.
Amend, H. S., 1331 South Ninth Street, Lincoln, Nebr.
Anawalt, H., Puget Sound Power and Light Company, Seattle, Wash.
Andrasko, J. P., 2136 Harrison Avenue, New York, N. Y.
Angle, F. C., Allis-Chalmers Manufacturing Company, San Francisco, Calif.
Anzini, D. I. (Member), General Electric Company, San Francisco, Calif.
Archer, M. M., The Detroit Edison Company, Detroit, Mich.
Arciola, T. A., Habirshaw Cable and Wire Corporation, Yonkers, N. Y.
Argo, J. P. (Member), Memphis Power and Light Company, Memphis, Tenn.
Ashworth, F., Canada Wire and Cable Company, Ltd., Toronto, Ont.
Baltera, A., New York Telephone Company, New York, N. Y.
Barnitz, R. W., The Pennsylvania Railroad, Columbia, Pa.
Barraford, J. H., Consolidated Edison Company of New York, Inc., Brooklyn, N. Y.
Barron, H. B., General Electric Company, Schenectady, N. Y.
Barry, T. F., Roberts and McInnis, Washington, D. C.
Beasley, O. A., Orlando Utilities Commission, Orlando, Fla.
Bell, R. B., King-Seeley Corporation, Ann Arbor, Mich.
Bentzel, R. J., American Gas and Electric Service Corporation, New York, N. Y.
Betz, J. F., Public Service Electric and Gas Company, Newark, N. J.
Billman, C. H., Ohio Power Company, Canton.
Birkes, R. C., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Blanchard, H. P., Pacific Telephone and Telegraph Company, Oakland, Calif.
Blume, A. E., 22 Maple Street, Brooklyn, N. Y.
Blumenthal, S. C., Jr., Blumenthal-Kahn Electric Company, Baltimore, Md.
Boagey, T., Tri-State College, Angola, Ind.
Bodenburg, J., 23–59 36th Street, Long Island City, N. Y.
Bollaert, R., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Bond, E. M. Jr., Stewart Warner Corporation, Chicago, Ill.
Bradt, R. S., Standard Oil Company of California, San Francisco.
Brice, W. E., General Electric Company, Schenectady, N. Y.
Brignall, H. L., Canadian Pacific Railway Building, Toronto, Ont., Canada.
Brinen, P. F., Young Radiator Company, Racine, Wis.
Brooks, F. E., New York Telephone Company, New York, N. Y.
Browning, E. E., Jr. (Member), American Telephone and Telegraph Company, New York, N. Y.
Buechler, L. W., Sears Roebuck and Company, Chicago, Ill.
Burnett, W. G., Jr., General Electric Company, Pittsfield, Mass.
Burson, C. H., 6549 Palatine Avenue, Seattle, Wash.
Campbell, C. E., General Electric Company, Schenectady, N. Y.
Campbell, D. L., City of Seattle, Wash.
Campbell, H. B., United States Engineers Ft. Peck, Mont.
Carter, W. R., National Light and Power Company, Moose Jaw, Sask., Canada.
Cassell, G. J., Long Island Lighting Company, Long Island, N. Y.
Cherksey, A. C., Electric Heating Equipment Company, Philadelphia, Pa.
Christensen, H., Bell Telephone Laboratories, Inc., New York, N. Y.
Christenson, R. W., 2517 Virginia Street, Everett, Wash.
Clark, L. W., Agricultural Adjustment Administration, Washington, D. C.
Climenson, M. G., University of Washington, Seattle.
Cobb, H. E., Allen-Bradley Company, Milwaukee, Wis.
Cogsdill, W. L., The Detroit Edison Company, Detroit, Mich.
Cohn, B. E. (Member), University of Denver, Denver, Colo.
Coone, L. A., General Electric Company, Schenectady, N. Y.
Cooper, B., Marlton, N. J.
Coxworth, V. B., Canadian General Electric Company, Ltd., Peterboro, Ont.
Crandell, C. F., Southwestern Bell Telephone Company, Kansas City, Mo.
Crouse, D. A., Ohio Power Company, Canton.
Cruikshank, M. T., Bell Telephone Company of Pennsylvania, Pittsburgh.
Cruse, A. W. (Member), Federal Communications Commission, Washington, D. C.
Dahlborg, J. E., Western Electric Company, South Kearny, N. J.
Dean, A. B., Jr., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Depp, W. A., Bell Telephone Laboratories, Inc., New York, N. Y.
Detrick, H. B., General Electric Company, Schenectady, N. Y.
Dobson, H. O., 416 1/2 South Madison Street, Iowa City, Iowa.
Dumaresq, J. E., 133–03 41st Road, Flushing, N. Y.
Ecker, L. F. (Member), Illinois Iowa Power Corporation, East St. Louis, Ill.
Ehmann, G. C., Jr., 1636 Ritner Street, Philadelphia, Pa.
Ekvall, A. C., Bell Telephone Laboratories, Inc., New York, N. Y.
Endlich, R. J., Harnischfeger Corporation, Milwaukee, Wis.
Fales, F. G., 372 Granite Avenue, East Milton, Mass.
Fergg, W. F., Consolidated Edison Company of New York, Inc., New York, N. Y.
Fernald, F. W., General Electric Company, Lynn, Mass.
Folk, W., Jr., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Foote, R. P., The Pennsylvania Railroad, Columbia, Pa.
Forestek, C. W., Forestek Plating and Manufacturing Company, Cleveland, Ohio.
Fowler, R. C., Delco Products Corporation, Dayton, Ohio.
Friedl, G., Jr. (Member), International Projector Corporation, New York, N. Y.
Frost, L. H. (Member), Electric Controller and Manufacturing Company, Cleveland, Ohio.
Frost, W. F., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Fry, H., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Gaylord, A. K. (Member), Portland General Electric Company, Portland, Ore.
Geiger, L. H., Jr., 1063 Oakdale Road, Atlanta, Ga.
Gerlough, D. L., Mott-Smith Corporation, Houston, Texas.
Getz, G. G., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Gibbons, R. F., Pacific Electric Manufacturing Corporation, San Francisco, Calif.
Gifford, F. T., 94 Faxon Road, Quincy, Mass.
Gilmer, T. P. (Member), Public Service Company, Okmulgee, Okla.
Gleeson, R. G., 163 Friendly Road, Auburn, R. I.
Glogan, M. L., Allen-Bradley Company, Milwaukee, Wis.
Goedde, L. O., Jr., 8100 Washington, Vinita Park, St. Louis County, Mo.
Gorman, W. J., Jr., General Electric Company, Schenectady, N. Y.
Gould, C. C., Carnegie-Illinois Steel Corporation, Gary, Ind.
Graef, R. P., 1135 Seton Avenue, Cincinnati, Ohio.
Gretz, C. B., New Jersey Bell Telephone Company, Newark.
Grim, C. L., 8 Beaumont Avenue, Catonsville, Md.
Grimshaw, W. R. (Member), Philtower Building, Tulsa, Okla.
Grissinger, G. G. (Member), Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Gunter, D. L., General Electric Company, Schenectady, N. Y.
Guy, J. D. C., Jr., General Electric Company, Schenectady, N. Y.
Haas, O. A., Allis-Chalmers Manufacturing Company, Tulsa, Okla.
Haller, R. R., 3000 Davis Street, Dover, Ohio.
Hanke, E. W. F., Allen-Bradley Company, Milwaukee, Wis.
Hanks, W. W. (Member), Southern Electric Service Company, Charlotte, N. C.
Hannum, W. F., Public Service Company of Northern Illinois, Chicago, Ill.
Hanson, L., Consolidated Coppermines Corporation, Kimberly, Nev.
Hardaker, E. H., Wisconsin Gas and Electric Company, Racine.
Hare, S. B., 209 North 34th Street, Philadelphia, Pa.
Harris, H. H., General Electric Company, Schenectady, N. Y.
Harris, W. R., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Harrison, F. E., General Motors Corporation, Anderson, Ind.
Hawkins, H. G., Electric Power Equipment, Ltd., Vancouver, B. C., Canada.
Hay, T. M., Jr., United States Army, Fort Monmouth, Oceanport, N. J.
Haynes, R. L., 1921 Sewell, Lincoln, Nebr.
Hegy, J., 67 South Fifth Street, San Jose, Calif.
Heiner, S. M., Box 158, Morgan, Utah.
Herbert, C. V., Texas Electric Service Company, Handley.
Herbig, E. T., Jr., Thomas A. Edison, Inc., New York, N. Y.
Herzfeld, C. E., Westinghouse Electric and Manufacturing Company, Houston, Texas.
Hicks, W. A., Southern Bell Telephone and Telegraph Company, Atlanta, Ga.
Hill, H. H., American Gas Association, Los Angeles, Calif.
Hillebrandt, B. F., Jr., Union Electric Company of Missouri, Webster Groves.
Hockenberger, R. H., Delco Appliance Corporation, Rochester, N. Y.
Hodge, R. D., Canadian General Electric Company, Ltd., Toronto, Ont.
Holden, E. A. (Fellow), Ebasco Services, Inc., New York, N. Y.
Howard, J. T., Tennessee Valley Authority, Chattanooga, Tenn.
Hurt, G. T., Tennessee Valley Authority, Guntersville Dam, Ala.
Jacobs, P. C., Allis-Chalmers Manufacturing Company, Boston, Mass.
Jarrett, W. R., General Electric Company, Schenectady, N. Y.
Jones, D. K., 1241 South Tenth Street, Lincoln, Nebr.
Jones, R. B., Jr., Chesapeake and Potomac Telephone Company of Virginia, Richmond.
Kadison, L., Crocker-Wheeler Company, Inc., Ampere, N. J.
Kaiser, R. W., International Business Machines Corporation, Milwaukee, Wis.
Kaltenberger, L. H., 1007 Third Avenue, Longmont, Colo.
Kanable, G. M., General Electric Company, Erie, Pa.
Kasakoff, H., 4252 Parkside Avenue, Philadelphia, Pa.
Keil, H. D., Canadian Westinghouse Company, Hamilton, Ont.
Kelly, J. P., Western Electric Company, Baltimore, Md.
King, J. A., Oklahoma Gas and Electric Company, Poteau.
King, W. H., Western Electric Company, Austin, Texas.
Kingston, C. R., Westinghouse Electric and Manufacturing Company, Houston, Texas.
Kirk, C. B., Jr., Chesapeake and Potomac Telephone Company of Virginia, Blacksburg.
Kistler, L. H., Northwestern Electric Company, Portland, Ore.
Knochel, W. J., Westinghouse Lamp Division, Bloomfield, N. J.
Kozlowski, E. W., Diehl Manufacturing Company, Elizabethport, N. J.
Kuczek, R., 74 Plain Street, Taunton, Mass.
Kuhnke, W. C., 2966 South 47th Street, Milwaukee, Wis.
Lee, E. H., Lee and Company, Volga, S. D.
Lefgren, A. H., Otis Elevator Company, New York, N. Y.
Lenkerd, J. P., Works Progress Administration, Gainesville, Fla.
Libby, C. P., City of Seattle Light Department, Seattle, Wash.
Linden, C. A., General Electric Company, Pittsfield, Mass.
Link, J. H., Federal Communications Commission, Washington, D. C.
Lloyd, L. H., Idaho Power Company, American Falls.
Lockwood, H. J. (Member), Manhattan College, New York, N. Y.
Loehr, R. W., Westinghouse Electric and Manufacturing Company, Cleveland, Ohio.
Longobardi, V., Jr., Brooklyn Edison Company, Brooklyn, N. Y.
Louraie-Sulekse, A. R., 3454 North Bremen Street, Milwaukee, Wis.
Ludlow, F. W., Bethlehem Steel Company, Sparrows Point, Md.
Lukens, D. W., Ohio Power Company, Coshocton.
Lyman, R. J., Narragansett Electric Company, Edgewood, R. I.
MacLaughlin, L. H., Cincinnati and Suburban Bell Telephone Company, Cincinnati, Ohio.
Malloy, N. M., Consolidated Edison Company of New York, New York, N. Y.
Manos, E. M., 3301 South Wallace Street, Chicago, Ill.
Maple, C. A., Dayton Power and Light Company, Dayton, Ohio.
Marans, A., Bethlehem Steel Company, Sparrows Point, Md.
Marshall, R. W., Bell Telephone Laboratories, Inc., New York, N. Y.
Martinson, L. A., General Electric Company, Schenectady, N. Y.

Massie, C. C., General Electric Company, Schenectady, N. Y.
Matthews, E. M., Jr., Western Electric Company, Kearny, N. J.
Maynard, H. M., National Youth Administration, Quoddy Village, Eastport, Me.
McCann, G. D., Jr., California Institute of Technology, Pasadena.
McClay, M. L., Utah Power and Light Company, Salt Lake City.
McDaniel, R. S., Magnolia Petroleum Company, Beaumont, Texas.
McEahern, E. J., M. McEahern Construction Company, Denver, Colo.
McKinley, R., Westington Electric and Manufacturing Company, Sharon, Pa.
McMillan, A. N., Buffalo Niagara Electric Corporation, Buffalo, N. Y.
McNall, J. W., Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.
McWilliams, J. L., Shawinigan Water and Power Company, Rapide Blanc, Que., Canada.
Merow, L. F., Consolidated Edison Company of New York, Inc., New York, N. Y.
Middleton, W. I., Simplex Wire and Cable Company, Cambridge, Mass.
Miller, I. S., Kansas Gas and Electric Company, Wichita, Kans.
Mintz, F. C., Humble Oil and Refining Company, Houston, Texas.
Mitchell, W. G., Singer Sewing Machine Company, Elizabethport, N. J.
Mohns, J. C., Bureau of Engineering, San Francisco, Calif.
Montgomery, J. R., Houston Lighting and Power Company, Houston, Texas.
Moore, W. H., Sperry Products, Inc., Brooklyn, N. Y.
Morris, B. C., General Electric Company, Philadelphia, Pa.
Morrison, P., Carnegie-Illinois Steel Corporation, Chicago, Ill.
Munson, H. J., 19 Bradley Road, Tacoma, Wash.
Murphy, L. T., Memphis Light and Water Division, Memphis, Tenn.
Nichols, R. M., Texaco Development Corporation, Los Angeles, Calif.
Nielsen, G. E., Federal Communications Commission, Washington, D. C.
Norton, R. B. (Member), Kerite Insulated Wire and Cable Company, Seymour, Conn.
Nunan, K., 440 South Grand Oaks Avenue, Pasadena, Calif.
Oakley, A. W., Jr., 610 West High Street, Terrell, Texas.
O'Connor, T. J., General Electric Company, West Lynn, Mass.
Odessey, P. H., Heyer Products Company, Inc., Belleville, N. J.
O'Leary, J. T., Bell Telephone Laboratories, Inc., New York, N. Y.
Olsen, J. W., Owens-Illinois Glass Company, Clarion, Pa.
O'Neil, F. S., American Telephone and Telegraph Company, New York, N. Y.
Orem, S. R., Jr., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Owens, O. G., General Electric Company, Pittsfield, Mass.
Owings, C. E., General Electric Company, Pittsfield, Mass.
Palmer, H. C., General Railway Signal Company, Rochester, N. Y.
Peckham, M. A., General Electric Company, Schenectady, N. Y.
Peery, W. E., Bell Telephone Laboratories, Inc., New York, N. Y.
Peterson, W. L., Allis-Chalmers Manufacturing Company, West Allis, Wis.
Phares, J. A., Interstate Electric Company, Fort Smith, Ark.
Pilger, C. F., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Plummer, W. B., RCA Communications, Inc., Tuckerton, N. J.
Pope, E. B., General Electric Company, Schenectady, N. Y.
Porter, R. W., General Electric Company, Schenectady, N. Y.
Porter, T. R., Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.
Powell, A. H., General Electric Company, Philadelphia, Pa.
Pratt, G. B., 4303 Tyler Avenue, Detroit, Mich.
Price, W., Price Engineering Service, Brookline, Mass.
Pugh, H. F., 2375 East Evans, Denver, Colo.
Pyle, K. N., Ingersoll-Rand Company, Phillipsburg, N. J.
Rauh, E. M., Southwestern Light and Power Company, Lawton, Okla.
Rechif, F. A., Continental Oil Company, Ponca City, Okla.
Rehm, T. C., Bell Telephone Laboratories, Inc., New York, N. Y.
Ridley, C. R., The Macnick Company, Tulsa, Okla.
Riechers, T. W., Northern Indiana Public Service Company, Hammond, Ind.
Risler, C. B., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Rittenhouse, S. A., Consolidated Gas Electric Light and Power Company, Baltimore, Md.
Roberts, J. D., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Robertson, G. M., General Electric Company, Pittsfield, Mass.
Roehm, P. R., New Orleans Public Service, Inc., New Orleans, La.
Rohweder, J. H. (Member), Citizens Light and Power Company, Erie, Mich.
Romanko, N. P., Raritan Copper Works, Perth Amboy, N. J.
Ruwell, R. G. Bell Telephone Company of Pennsylvania, Philadelphia, Pa.
Ryan, J. C., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Saalbach, H. K., United States Patent Office, Washington, D. C.
Sampers, H. C., Nebraska Power Company, Omaha, Nebr.
Sampson, L. H., The Detroit Edison Company, Detroit, Mich.
Sander, H. F., Bell Telephone Company of Pennsylvania, Pittsburgh.
Sanderford, R. B., Tennessee Valley Authority, Memphis, Tenn.
Saunders, H. M., Western Union Telegraph Company, New York, N. Y.
Saylor, W. R., General Electric Company, Philadelphia, Pa.
Scarborough, H. V., Jr., General Electric Company, Schenectady, N. Y.
Schmalbach, S., Mooradian High Frequency Laboratories, Bogota, N. J.
Schmand, D. A., 1416 Center Street, Little Rock, Ark.
Schmidt, L. B., Denver Rio Grande Western Railroad Company, Grand Junction, Colo.
Schulman, I., Bethlehem Construction and Utilities Company, New York, N. Y.
Schumaker, I. R., Jr., General Electric Company, Schenectady, N. Y.
Schumann, L. L., 3425 Kossuth Avenue, New York, N. Y.
Schwartz, D. A., 1701 South Gayoso Street, New Orleans, La.
Semrad, C. J., General Electric Company, Schenectady, N. Y.
Settle, C., 2003 Columbia Road, N. W., Washington, D. C.
Sharkey, E. H., Bell Telephone Laboratories, Inc., New York, N. Y.
Sheen, R. G., Public Service Company of Colorado, Denver.
Shideler, J. J., Western Electric Company, Des Moines, Iowa.
Shorey, L. F., University of Vermont, Burlington.
Shumaker, L. L., Delco Products Corporation, Dayton, Ohio.
Shutts, R. C., General Electric Company, Philadelphia, Pa.
Simpson, R. L., General Electric Company, Schenectady, N. Y.
Slepian, A., Wheeler Insulated Wire Company, Bridgeport, Conn.
Sloan, C. D., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Smith, D. W., American Rolling Mill Company, Butler, Pa.
Smith, E. S., Eclipse Aviation Corporation, East Orange, N. J.
Smith, V. L., Civilian Conservation Corps, Camp S-80, Masten, Pa.
Spence, B. G., Oklahoma Gas and Electric Company, Enid, Okla.
Staley, K. (Member), General Electric Company, New York, N. Y.
Steen, E. M., Commonwealth Edison Company, Chicago, Ill.
Stefanetti, Henry J., Pacific Gas and Electric Company, Red Bluff, Calif.
Stewart, H. J., General Electric Company, York, Pa.
Stewart, V. N., General Electric Company, Schenectady, N. Y.
Stillwell, R. M., Union Electric Company of Illinois, Alton.
Stipe, J. L., General Electric Company, Schenectady, N. Y.
Storck, N. C., Milwaukee Electric Railway and Light Company, Milwaukee, Wis.
Strandrud, H. T., United States Bureau of Reclamation, Ephrata, Washington.
Thomas, M. E., Phillips Petroleum Company, Bartlesville, Okla.
Tibbets, W. S., Bethlehem Steel Company, Sparrows Point, Md.
Tipple, H. L., Canadian National Carbon Company, Ltd., Toronto, Ont.
Touton, L. L., Jr., Allis-Chalmers Manufacturing Company, West Allis, Wis.
Townsend, M. A., General Electric Vapor Lamp Company, Hoboken, N. J.
Treseder, R. C., Mountain States Telephone and Telegraph Company, Salt Lake City, Utah.
van de Kamp, W., Westinghouse Electric and Manufacturing Company, Emeryville, Calif.
Van Lund, J. A., Jr., General Electric Company, Schenectady, N. Y.
Vaughan, H. E., Bell Telephone Laboratories, Inc., New York, N. Y.
Vaughn, R. W., Memphis Light and Water Division, Memphis, Tenn.
Waddington, L. A., Mountain States Telephone and Telegraph Company, Denver, Colo.
Wallace, W. E., General Electric Company, Schenectady, N. Y.
Watson, F. L., Keystone Telephone Company of Philadelphia, Philadelphia, Pa.
Wearly, W. L., Joy Manufacturing Company, Franklin, Pa.
Weber, V. D., Oklahoma Gas and Electric Company, Enid.
Weiman, D. N., 393 East 18th Street, Brooklyn, N. Y.
Welch, D. R., Sinclair Refining Company, Tulsa, Okla.
Weller, R. N., Consolidated Edison Company of New York, Inc., New York, N. Y.
Wenzel, F. E., Louis Allis Company, Milwaukee, Wis.
Wiederkehr, K. P., Allis-Chalmers Manufacturing Company, Milwaukee, Wis.
Wilcox, S. C., 10515 Wilbur Avenue, Cleveland, Ohio.
Wiley, D. G., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Wilson, N. E., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Willcox, T. N., General Electric Company, Schenectady, N. Y.
Willennar, A. H., Indiana and Michigan Electric Company, Fort Wayne, Ind.
Willey, F. G., General Electric Company, Erie, Pa.
Williams, R. E., Jr., General Electric Company, Schenectady, N. Y.
Williamson, T. D., Jr., Petroleum Engineering and Equipment Company, Tulsa, Okla.
Wood, D. O., Hygrade-Sylvania Corporation, Salem, Mass.
Wood, E. I., Westinghouse Electric and Manufacturing Company, Houston, Texas.
Wright, S. K., New England Power Company, Readsboro, Vt.
Young, C. M., General Electric Company, Schenectady, N. Y.
Young, J. L. H., Southern Bell Telephone and Telegraph Company, New Orleans, La.
Zima, L. C., 1678 Appleton Avenue, New York, N. Y.

Total, United States and Canada—303

Elsewhere

Clinchard, W. C., Jr., Box 1545, San Juan, Porto Rico.
Gittoes, C. S. (Member), Ducon Condenser Pty., Ltd., Waterloo, Sydney, Australia.
Havinga, T. H., Box 13, Christiana, Transvaal, South Africa.
Kuai, S. C., Lane 45, House No. 6, Great Western Road, Shanghai, China.
Miller, A. K., Panama Canal, Balboa Heights, Canal Zone.
Moorthy, C. V. D., Osmania Central Technical Institute, Hyderabad, Deccan, India.
Wills, E. H., Howard Smith, Ltd., Townsville, North Queensland, Australia.

Total elsewhere—7

Engineering Literature

New Books in the Societies Library

Among the new books received at the Engineering Societies Library, New York, recently are the following which have been selected because of their possible interest to the electrical engineer. Unless otherwise specified, books listed have been presented gratis by the publishers. The Institute assumes no responsibility for statements made in the following outlines, information for which is taken from the preface of the book in question.

RADIO AMATEUR'S HANDBOOK. 1938. Edited by the American Radio Relay League. 15th edition. West Hartford, Conn., 446 pages, illustrations, 10 by 7 inches, paper, $1.00. Covers comprehensively the amateur short-wave field. Describes the fundamental principles and the design, construction and operation, of transmitting and receiving apparatus.

INDIAN WATER POWER PLANTS, a companion volume to Hydro-Electric Installations of India. By Shiv Narayan. Published by Brij Narayan, Poona Electric Supply Company, Ltd., Ganeshkhind Road, Poona 5, India, 1937. 172 pages, illustrated, 10 by 7 inches, cloth, Rs. 5/-. Descriptive information concerning hydro-electric plants and projects of the past decade in India and Burma, geographically divided, showing the progress and present position of Indian hydro-electric power.

LIST of RETIREMENT UNITS for ELECTRIC UTILITIES, prepared by Committee on Statistics and Accounts of Public Utility Companies of National Association of Railroad and Utilities Commissioners. New York, State Law Reporting Company, 1937. 21 pages, mimeographed, 11 by 9 inches, paper, $0.65. A supplement to the Uniform System of Accounts for Electric Utilities. Its purpose is to create greater uniformity in accounting for replacements of property and for depreciation by providing more accurate and uniform distinction between replacements which should be classed as property additions and those to be classed as maintenance.